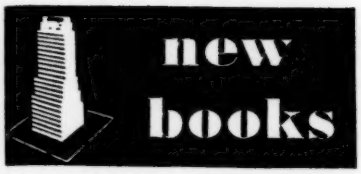

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BULLETIN OF THE ATOMIC SCIENTISTS

Founded in 1945 by Hyman H. Goldsmith and Eugene Rabinowitch

Vol. VIII April, 1952 No. 4

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Published monthly by the Educational Foundation for Nuclear Science, Inc., 935 E. 58th Street, Chicago 37. Phone: MIdway 3-3056. Manuscripts should be sent in duplicate to the Managing Editor at the above address. Publication date: 15th of the month. Subscription and advertising service: All correspondence in regard to changes of address, new subscriptions, and advertising rates, should be sent to 35 W. Jackson Blvd., Chicago 4, Ill. Subscription—$5.00 a year. Single copy—50 cents. Four weeks notice is required for change of address: both old and new addresses must be given. Entered as second class matter at the Post Office at Chicago, Illinois, under the act of March 3, 1879. The opinions expressed in the "Bulletin" do not represent the official views of any organization.

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NATIONAL SCIENCE FOUNDATION: ANOTHER ROUND

CLIFFORD GROBSTEIN

Part of the failure of the National Science Foundation to secure an adequate appropriation in the first year of its existence has been laid at the door of the scientists themselves. In a recent interview which the Bulletin *conducted with Senator Brien McMahon, the Senator accused scientists of doing "a poor public relations job." The Senator admitted that the drastic curtailment of NSF funds "demonstrated a complete lack of understanding of what is necessary in a scientific way in this country" and urged the* Bulletin *to conduct a campaign of public and congressional enlightenment as to what the National Science Foundation is set up to do.*

A new budget is being considered in Congress, and again the National Science Foundation's requests are being radically cut. Mr. Grobstein, former vice-chairman of the Federation of American Scientists and editor of the Federation's Newsletter, *undertakes in this article to explain what the Foundation should mean to American science and why its fiscal starvation is poor economy for the nation.*

The Bulletin *hopes that American scientists individually, and through their professional organizations, will not once again let the National Science Foundation be emasculated without a fight. Mr. Grobstein speaks of the alternative for the scientists to feel amused or insulted by the three-and-one-half million allotted to the NSF. We suggest that the scientists choose the second alternative and act accordingly.*

AS THIS is written, a new budget battle is under way for the National Science Foundation. The House of Representatives, following the recommendation of its Appropriations Committee, has slashed the Presidential request for $15 million as far as decency will permit—to the $3.5 million allotted to NSF for the current year.[1] In its report, the House Committee professes to be "aware of the importance of [NSF] and the program which it sponsors and it is reluctant to retard development of it." Nevertheless, it finds that this "is a new activity which is unlikely to provide assistance to the country in the immediate emergency." Thus, opponents of the Foundation have once again effectively combined forces with the economy bloc to threaten drastic curtailment of NSF hopes and potentialities. As in 1951, scientists, and others who look beyond their noses, must appeal to the Senate to raise the figure if the new agency is to rise at all from the level of frustration at which it has so far been maintained.

This second axing by the House Committee should bring home to scientists once and for all that they will have to get in and dig if we are ever to have a substantial NSF. Creation of the Foundation in 1950 came only after a series of compromises, both legislative and through the medium of gentleman's agreements, that weakened the agency both in conception and powers. Its present shaky existence is to be credited almost entirely to the continued interest and insistence of the Executive Branch and a few enlightened legislators.

MERE EXISTENCE NOT ENOUGH

But existence is not enough. The majority of scientists who asked for passage of the Act were not seeking to add another trickle to the vast flood of federal funds already flowing. They were asking for a means to a wiser, more effective use of federal funds—something in which an economy Congress should certainly be interested. They wanted an agency to give top-level, over-all guidance to Congress and the President; to bring balance into federal support of science; to cultivate science as an indispensable resource rather than to exploit it for its gadgets. This is now almost forgotten in the desperate struggle to keep NSF barely alive. *A barely alive NSF is no good.* There is no real need for another minor hand-out window. NSF must be big, and must be taken seriously, if it is to do the real job that needs doing.

How big should it be? In 1945, when the lessons of World War II were yet fresh in mind, Vannevar Bush in his book, *Science the Endless Frontier*, recommended $33.5 million for the proposed agency's first year—just to make "modest beginnings." By the fifth year of operations—last year, according to Bush's schedule—he en-

[1] As anticipated, the House on March 21 accepted the Appropriations Committee's figure for NSF. It beat down, on a voice vote, an amendment by Percy Priest (D., Tenn.) to raise the appropriation to $10.5 million. The debate on the amendment indicated no specific unfriendliness toward NSF. The decision obviously was dominated by the economy bloc.

visioned an annual budget of $122.5 million.

In 1947, the Steelman Committee reassessed our scientific status and recommended that the still-to-be-created NSF "be authorized to spend $50 million in support of basic research its first year, with increasing amounts thereafter, rising to an annual rate of at least $250,000,000 by 1957."[2] These estimates were in terms of pre-inflation dollars. Yet for fiscal 1952–53, with Congress considering a recommended national budget of $86 billion, including $1.4 *billion* for military research and development, the House Appropriations Committee reduces the NSF request to $3.5 million —about the cost of a *single* major scientific institution.

Scientists and their organizations cannot escape some share of the blame for this situation. The enthusiasm and purpose of the early years of the legislative struggle have distinctly waned. With the passage of the Act, the specific objective which motivated the dogged determination of the later legislative years has disappeared as well. The tendency has been to sit back and give the seed time to germinate without too much heckling. The germination has been quiet, probably too quiet. But the climate has been poor, and the shoot is in grave danger of being so badly stunted that it will never become anything more than a dwarfed and distorted caricature of its original conception.

THE PURPOSE OF THE NSF

What is that conception? Broadly, as specified in the preamble to the Act, it is "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes." Section III spells this out specifically, in clear language which takes cognizance of the urgent necessities of the present and future, and prescribes the essential first steps to meet them. The Foundation, among other things, is authorized and *directed* "to develop and encourage the pursuit of a national policy for the promotion of basic research and education in the sciences." In 1947, the Steelman Committee pointed out that "the United States has no unified or comprehensive policy on scientific research or the

[2] *Science and Public Policy*, Volume I, "A Report to the President by John R. Steelman, Chairman, The President's Scientific Research Board, Aug. 27, 1947," page 31.

support of science." If NSF had no other responsibility than to fill this gap, it would still have a major contribution to make, one which would justify ample support despite claims of the "immediate emergency."

But, in addition, the Foundation is authorized and *directed* by the Act: "to appraise the impact of research upon industrial development and upon the general welfare"; "to evaluate scientific research programs undertaken by agencies of the Federal Government"; "to correlate the Foundation's scientific research programs with those undertaken by individuals and by public and private research groups"; "to foster the interchange of scientific information among scientists in the United States and foreign countries"; "to initiate and support basic scientific research"; "to award . . . scholarships and graduate fellowships." In short, the mandate of the 81st Congress to NSF was to make and keep the U.S. strong in science, with particular attention to the stimulation of basic research and scientific education. On this the House Appropriations Committee of the 82nd Congress sets a price tag of $3.5 million. For scientists and others who know the costs and values involved, it is hard to decide whether to be amused or insulted.

THE PRESIDENT'S ATTITUDE

The Executive Branch has given every indication that it understands the original congressional mandate and wishes to implement it. This is natural. The far-flung research programs of the federal government were an administrative problem even before World War II. Since then they have become an administrative nightmare. Top officials seeking to evaluate proposed or existing research programs—the bulk of them involving nongovernmental organization and having tremendous impact on education, the tight supply of specialized personnel, and scientific development in general—find themselves without carefully conceived general policies to guide them. Who today has an over-all picture of U.S. science, its capacities, its needs, its shortcomings? The Budget Bureau, the President's fiscal policeman whose functions have grown until it is a kind of general staff or government-in-miniature, is hopeful that when NSF assumes its policy functions it will greatly assist the Bureau in rationalizing and improving the federal science program. In these days, whether we like it or not, *this means a large proportion of American science.*

The President, in his letter to Congress transmitting the first NSF *Annual Report*, clearly expressed the Executive conception of the role of the agency:

> The Foundation is much more than a new executive agency added to those already in existence with a research mission. It was conceived as a much-needed keystone in the structure of the national research program. Its principal task is to appraise the rapid growth of research activity, both public and private, and to recommend the broad goals toward which this massive effort should be channeled. In addition, the Foundation will support those areas of basic research and scien-

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tific training where the needs are most acute and will ultimately assume major responsibility for the Federal Government's support of basic research through grant or contract. As long as the Federal Government continues to be the largest factor in the national research effort, it must frankly face the responsibility to insure that this effort is conceived and executed soundly and effectively.

THE FIRST YEAR'S ACCOMPLISHMENTS

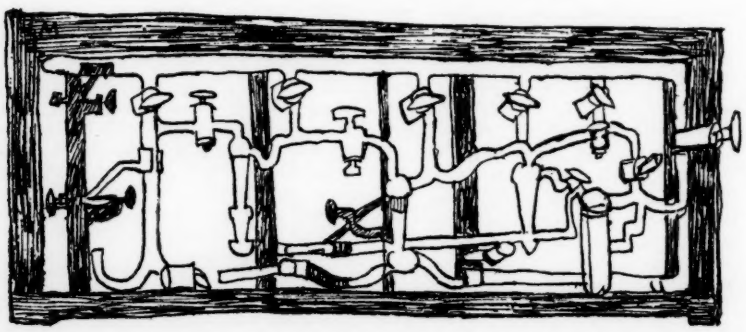
What has NSF been able to do so far? Not a lot. Operating on a short and uncertain budget it has had to face, in addition, scientific, public, and congressional apathy in causal order. Over all are the abnormal requirements of a mobilization program of ill-defined duration. To get any attention at all in the congressional maelstrom, NSF has felt it necessary to concentrate on immediately and easily justifiable programs rather than on its long-range objectives. Major emphasis has been placed on the fellowship program and on grants in support of research. Proceeding at a much slower pace are efforts to assess the current national science picture so as to provide the basis for sound policy to guide all support programs, both public and private.

In its initial year, the fellowship program, with the National Research Council acting under contract to screen and evaluate applications, drew nearly 3,000 requests from every state and territory. Owing to budgetary limitations the number of successful applicants will not be much over 400. Next year, when the program is better known, an even larger flood of applications can be anticipated, and an even smaller proportion will be accommodated on the $3.5 million doled out by the House Appropriations Committee.

A similar picture exists in the grants program. The Biology Division was first to launch its activities. On February 9 it announced its first 28 awards totalling $410,000. These had been selected from some 70 applications for approximately $2 million. Certainly not all of these applicants deserved support. But it is clear that even in its first active year, with a good deal of confusion and misunderstanding still existing in the scientific community on the precise role NSF is to play, its meager funds were greatly oversubscribed.

THE CENTRAL TASKS UNFULFILLED

But these "give-away" programs are not the heart of NSF. It was never anticipated that NSF would compete with larger, better established agencies in volume of direct support of research. Rather, the direct support programs are to be judiciously used to supplement other programs, and thus to implement the national policy which NSF has prime responsibility to formulate. It is not so much the job of NSF to promote actual research as it is *to promote the conditions under which research can flourish.* Irving Langmuir has remarked, "You can't plan to make discoveries. But you can plan work that will probably lead to discoveries. . . . If you can't predict ideas, you can't plan things in a laboratory. But you can organize a laboratory so as to increase the probabilities that useful things will happen there. And, in so doing, keep the flexibility, keep the freedom." In the same fashion, attention must be given to organizing the conditions for effective research and its utilization on the *national level.* Encouragement for the creation of new centers in the scientifically underdeveloped areas of the nation, assistance in disentangling the snarl of scientific publication, awakening the public (and congressional) mind to the true nature and significance of basic research, dovetailing fundamental science with public health and technology—these are the central tasks of NSF. They can't be carried out on $3.5 million per year.



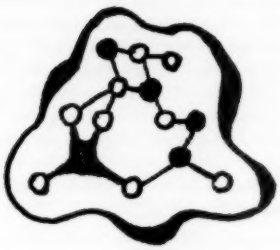
Within NSF there are those who fully understand the importance and magnitude of their responsibilities. They are appalled at the disparity between those responsibilities and the resources available to carry them out. With so little evidence of active support from scientists, and faced with an uninformed and unsympathetic Congress, it is understandable that they are proceeding slowly and cautiously. Thinking in the critical policy area has not yet fully crystallized. Director Waterman has noted that the policy function "is not one which we can assume all at once."[3] The problems and issues raised are legion and they have received little attention in the scientific community. How does one go about surveying the $2 billion-per-year enterprise that science has become in the United States? How does one appraise its impact "upon industrial development and upon the general welfare?" What criteria does one use even in evaluating a single area of science? And having surveyed and reached generally acceptable conclusions, how does one go about implementing them?

POOR ECONOMY

The functions and responsibilities assigned to the National Science Foundation are new for the U.S. in peacetime. The necessity for them arises out of the tremendous growth of American science, and its crucial importance for the national welfare in the present, and in the immediate and long-range future—whether in peace or war. The uniqueness and difficulties of these responsibilities are matched only by their importance—importance which places them far and above the short-sighted criterion applied by the House Appropriations Committee. For the job of NSF is nothing other than to ensure the health and productive strength of the goose which today and tomorrow and the next day Congress will go on expecting to lay golden eggs. It is very poor economy—and poor statesmanship—to be stingy on the diet for this particular goose. There may be fewer eggs, and less golden ones, possibly not in the lifetime of so transient a thing as a particular House Committee but soon enough to threaten the security of more enduring institutions and values in American life.

[3] Remarks by Dr. Alan T. Waterman, Director, NSF, before Congress on Medical Education and Licensure, American Medical Association; Chicago, Feb. 11, 1952.

PURE SCIENCE



SIR JOHN COCKCROFT

The author of the following article is the eminent British physicist who directs the British Atomic Research Establishment at Harwell. In 1951 Sir John Cockcroft and his collaborator, Dr. Ernest Walton, were awarded the Nobel Prize in physics for their development of the first electrical accelerator, which enabled them to achieve the first artificial transmutation of atoms by particles accelerated in an electrical field. This article was a lecture delivered in Oxford on August 9, 1951, and is reprinted from The British Atomic Scientists' News.

THE events of the last ten years have aroused a great deal of interest in the problem of scientific freedom, and, in particular, the responsibility of science and scientists for the deteriorating political state of the world. We ought therefore to think first of what has been meant in the past by scientific freedom and how this freedom is changing under the stress of world events. We ought then to consider how far science has, in fact, been responsible for the troubled state of the world and whether this has any effect on our attitude toward scientific freedom.

If we think now of the traditional scientific freedoms, they would include the freedom to work on any subjects in science; the freedom to publish one's results; the freedom to meet other scientists and discuss one's work fully with them. It is on these freedoms that the achievement and prestige of science has developed.

Suppose we now think of these freedoms as applied to a young research student at the Cavendish Laboratory in the period between the wars. I was a research student then, working under Lord Rutherford. The Laboratory was a center of fundamental work on nuclear physics, and of outstanding prestige and achievement. As young research students in that laboratory we were always encouraged to select our own problems for research work. It may be that some of us were not able to do that in the first place, and if so there was always a list of problems which had been provided by the senior staff and by Rutherford. These problems available to us would be within the broad field of interests of Rutherford, but an independent line was always accepted. Having started on our problems, we would get useful advice from senior and more experienced members of the staff on how to go about them, and, in particular, on the best technique to use. By and large, however, we were left to get on with the problems, and only occasionally was our progress looked over and judgment made on our achievements. Over a period of two or three years I and my colleagues were left with very complete freedom to develop our own line of work. There were never any grumbles about this, and in the end it paid dividends. One has to remember that in order to get the best out of laboratory work in pure science one has to leave a great deal of initiative to the young men.

PLANNING AND CONTROL OF SCIENCE

While we are talking about this question of freedom of choice, I ought to mention that there has been a great deal of discussion on the question whether the first of the scientific freedoms is likely to be imperiled in any way by an extension of state planning and control of science. The protagonists for and against planning have been typified by J. D. Bernal and M. Polanyi.

So far as this country is concerned, this is somewhat of an academic issue. It is true that university expenditure is more and more provided for by government funds. But the money is administered by the University Grants Committee under a system which provides universities with a grant for a quinquennium and leaves the university to decide how it will spend the money, whether on extra professorships of Greek or Sanskrit or more university lectureships, on libraries or on apparatus for scientific research. The only exception to this has been that very large items of expenditure on equipment for research in nuclear physics and a few other special projects have been financed by the Department of Scientific and Industrial Research on the recommendation of expert advisory committees To some extent, therefore, there has been an element of planning in providing for this exceptional expenditure, but it has not changed the broad picture. It is what we may expect in other fields of science in the future, for example, in the development of radio-astronomy in this country. An individual is not able to develop his work as he wishes from the normal resources of a university department, and we have to ask the government for exceptional expenditure in this particular field. To that extent, therefore, one is not free to say, "I will take up a line of work which will cost a quarter of a million pounds for putting in the apparatus." But these questions are always treated very intelligently and discussed very thoroughly.

If we look at scientific research outside the universities – research conducted by the Medical and the Agricultural Research Councils or by the Department of Scientific and Industrial Research or by the other Ministries such as the Ministry of Supply–there is, of course, a much greater element of planning since those departments have to work toward certain broad objectives or have to produce equipment to meet the requirements of the services. Even here, however, there is a great deal of scope for individual initiative and freedom. Probably 30 or 50 per cent of the work of the civil departments can be classed as fundamental or long-range research and as such is not plannable. In the Defense Research Establishments the propor-

tion of fundamental and long-range research will be less, varying perhaps between 5 and 20 per cent according to the nature of the establishment. But this does allow for those with special initiative and aptitude for basic research to work on fundamental problems and then have a change of work for two or three years on an applied subject. This freedom of movement from one side to the other is of great importance.

ORGANIZATION OF PERSONNEL

There is one other important question about work in large establishments. There is always a great danger in any large organization that a kind of hierarchy may develop and the freedom of individuals diminish. We at Harwell in particular have always done our best to avoid that, and we have done this by stressing the importance of the small research groups as the real basic units of our organization. The research groups are led by experienced scientists—young men of about thirty to thirty-five on the average—who have working with them perhaps half a dozen more junior scientists with an appropriate number of assistants. These groups are scientifically autonomous. They are not interfered with in any way in deciding how they will carry out their research. They are given their own facilities. They have their own little workshops and stores; they have some help with paper work. In that way we base our organization on the structure of perhaps fifty or sixty groups of this kind. Of course, they do need to have a certain amount of supervision. They cannot all discuss with the Director the problems they may have, and we have therefore senior scientists who correspond with the professors of universities, and the groups are covered in this way so that there is somebody equivalent to a university professor to whom they can go for advice. By that means we try to get away from the rigidity which is the great danger of large organizations. Everybody who has worked in science knows that the most efficient laboratories are the small ones, and the problem of large organizations is to recapture the efficiency and atmosphere of the small university laboratory.

On the whole, therefore, I think we cannot complain that scientific freedom in this country is imperiled by state planning. We must remember, too, that applied science has a responsibility to society to solve its innumerable technological problems, and that the balance I have described between long-range research and the requirements of society is probably the best balance that we can strike at the moment.

THE SITUATION IN RUSSIA

What is the situation in other countries? Perhaps the extreme opposite case is Soviet Russia where it is claimed that science is very highly planned. I have had no personal experience of what has gone on there over the last fifteen years, and the most recent testimony I can cite is that of Eric Ashby in his book, *Scientist in Russia* (Pelican Books, 1947), who writes: "The view is held by some enthusiasts in British countries that Soviet scientists by virtue of their organization and planning are able to accomplish wonders. This is not so. Notwithstanding all the propaganda to the contrary,

there is no profound difference of organization in this country and elsewhere." Mr. Ashby says that on paper every scientist works to a plan, and every problem has a bearing of some nature on the State. On paper it is all clearly prescribed. The State Planning Commission delegates the responsibility of planning science to the Academy, and the president of the Academy often releases a summary of the planning to the press. Actually, the situation is that the plan interrupts rather than aids scientific research, and as the scores of plans converge at high level they become less and less intelligible.

FREEDOM TO PUBLISH

The second freedom, freedom to publish, has always had one important qualification. One of the most important canons of science is that one must not publish without being as sure of one's results as is reasonably possible. In the entrance to the McGill Physics Laboratory, where Rutherford did some of his greatest work, there is written, "Prove all things." A scientist must repeat his experiments, time after time, until he is sure that he is observing a consistent behavior. Then only is he free to publish his results and to speculate about their interpretation. The greatest sin in science is to publish hastily the results of half-baked experiments; Rutherford never forgot or forgave sins of that kind.

THIRD FREEDOM

The third freedom, freedom of movement and discussion, was taken completely for granted in the scientific world of the 'thirties. Scientists of practically all countries met informally in the course of their travels or in small informal conferences held at leading centers of learning or in the larger international conferences organized by the International Unions. The first shadow on this freedom of science was cast by restriction on the freedom of travel by Soviet scientists which began about 1933.

If we now look at the state of these freedoms in post war years we can note some changes in the second of the freedoms and much more important changes in the third. The freedom of publication was affected by the discovery of nuclear fission in late 1938, with its obvious practical consequences. This coincided with the gathering war clouds, and a voluntary agreement was made between the scientists of the United States, Britain, and France to withhold publication of any work which might be of use in war. Later, as the war developed, this turned into a more formal prohibition of publication, and a great deal of nuclear physics came under a veil of secrecy. Immediately after the war, however, a government-sponsored committee of scientists was formed in the United States to consider how much information should be released from secrecy, and similar committees were formed in Canada and Great Britain. This resulted in the release of the greater part of the pure nuclear physics information which had been held secret during the war. This situation is reviewed at intervals by committees of scientists and further changes of policy are made. I do not remember a recommendation from those committees of scientists which has been rejected by governments, and in this way we have exercised our freedom together with responsibility.

RELEASE OF INFORMATION

The present position is that a very large fraction—at least 95 per cent—of the fundamental nuclear physics information held secret during the war is now free, and the remainder has no great importance to pure science. Secrecy has, in fact, only been retained

on matters of technological importance —in particular on all the details of construction of weapons and on the preparation of nuclear explosives. It can hardly be claimed that this retention is a restriction on the freedom of science. I do not, therefore, believe that scientific progress is being in any significant way restricted today by secrecy restrictions. During the last year, for example, we have published in scientific journals about one hundred twenty-five papers from Harwell alone. I cannot remember a case where governments have objected to the recommendations of the scientists. This is a good example of freedom combined with responsibility.

The third freedom, that of meeting for scientific discussion, has changed substantially, since there is now practically no freedom of movement out of the Eastern world and very little visiting of scientists from the Western world. Within the Western world there is still fairly complete freedom of movement and a plethora of scientific conferences at which discussions range practically as freely as in pre-war days. Somebody told me he had added up the scientific conferences in Europe and they numbered about two hundred fifty a year at present. On the whole we have rather too many conferences than too few. The only restriction on discussion is that scientists who worked on secret government projects during the war are not able to discuss those parts of their work which are still held secret under the rules of their government. We do not find this any disadvantage.

There are indeed signs and portents that this freedom of movement and discussion within the Western world may be subject to more restrictions in the future. This has resulted particularly from the passage in the United States of the Internal Security Act, 1950, carried against the veto of the President. As a result of this Act scientists now experience long delays in obtaining visas for visits to the United States, even for short-term conferences, while there are similar, though different, restrictions on the visits of United States scientists to some of the countries of the Western world. It is, I think, the future of this freedom within the Western world which gives scientists most concern at the present time. We believe that our country and the Western world is strong because there is freedom of thought, freedom of discussion, and political freedom. If we have confidence in our own strength we should see that these restrictions can only reduce our strength.

ABUSE OF FREEDOMS

I must now discuss the still larger issue as to whether scientists have abused their freedom and by so doing have led the world into its present troubles. There is no doubt, I think, that the events of the last war, with its holocausts of mass destruction by so-called strategic bombing, culminating in the destruction of the Japanese cities, has produced a very widespread fear of science. The belief in a steady progress guaranteed by the discoveries of science which was characteristic of the Victorian and Edwardian ages seems to have been largely destroyed by the overwhelming fear of the atom.

Are scientists responsible so far as their pre-war work is concerned? Perhaps I may refer again to the Cavendish Laboratory. In pre-war years we were working on the fundamental problems of nuclear physics. The general policy of the Laboratory at that time was described by Rutherford as late as 1937, when reviewing the work of the previous five years. At that time he did not himself believe that important practical consequences would follow and he said:—

"It was not that the experimenter was searching for a new source of power. . . . The real reason lay deeper and was bound up with the urge and fascination of a search into one of the deepest secrets of nature."

I do not think anybody in the Laboratory at that time believed that practical results would come from this fundamental study. Lord Rutherford himself was, among all the scientists of the world, remarkable for his gift of intuition and judgment. We can fairly claim, therefore, that it was impossible to predict at this time the remarkable practical developments which followed the discovery of nuclear fission. The history of science shows that this is quite generally the case. The major discontinuities in science cannot be predicted a decade or even five years ahead. We cannot, therefore, state at any particular time that this or that part of our work is likely to have important social consequences. I will go back to the period round about 1820 when one of the fundamental discoveries about the interaction of the magnetic field and conductors carrying electric current was made by accident in the course of a lecture demonstration. In the Cavendish Laboratory about 1933 artificial radioactivity was lying about for anybody to discover if he put two pieces of apparatus of the right kind together. In this sense, therefore, the question of responsibility or irresponsibility did not arise in a laboratory such as the Cavendish in pre-war years.

RESPONSIBILITY DURING WAR YEARS

Let us next think of the spring of 1940. We were confronted at that time with the overwhelming might of Germany which in short sequence had conquered Poland, Denmark, Norway, Holland, Belgium, and France. We had for some time become familiar with the frightful conditions of the concentration camp, the mass destruction of civilians, and a general recession of standards of behavior in Germany by at least five centuries. At this time the idea of using nuclear energy as a weapon was first suggested in our own country, and we learned that the Germans were working on what we believed to be an atomic bomb. The bomb was then no more than an idea, and several years of work were clearly necessary to prove its feasibility. At this stage governments were hardly interested, and the development of the project depended largely on whether British scientists believed in it and thought its development necessary in the interests of our country. Thinking back to those dark days of 1940 I am sure that we had no doubts as to where our duty lay. If Hitler had been able to develop the atomic bomb first he would undoubtedly have been able to defeat this country, and freedom might well have disappeared from the world. The project therefore went ahead, and within a year our government had been convinced of its feasibility. The immense resources of the United States were concentrated on the work, and by July 1945 a successful test of the project had been made. At this stage, responsibility for its use had passed to governments and in particular to statesmen. The scientists of the U. S. project felt, however, that they had a special personal responsibility

(*Continued on page 110*)

"A technician is a man who understands everything about his job except its ultimate purpose and its place in the order of the universe."

—Sir Richard Livingstone

HEARINGS ON THE NATIONAL SCIENCE FOUNDATION BUDGET

On January 15, 1952, the budget for the National Science Foundation was discussed before the House Subcommittee on Independent Offices of the Committee on Appropriations. Members of the Subcommittee included Albert Thomas, Texas, Chairman; Albert Gore, Tennessee; George W. Andrews, Alabama; Sidney R. Yates, Illinois; John Phillips, California; Frederic R. Coudert, Jr., New York; and Norris Cotton, New Hampshire. We present below a condensation of the transcript of the hearings.

STATEMENT BY THE CHAIRMAN OF THE BOARD

DR. CHESTER I. BARNARD (Chairman of NSF Board). This Board is made up of educators and scientists and a few men of affairs, all of whom, I think, have been associated with scientific activities from all over the country. The competence, if I may say so, is extraordinarily high.

The Board has given careful attention to all questions of policy including the budget. As it becomes seasoned and organized, it will be in a position to perform one of the major functions of its institution, which is to give mature and unbiased judgment to Congress on matters relating to science, particularly fundamental science.

There is always an element of uncertainty as to possibility of any particular field being amenable to research as carried on and also uncertainty as to whether you can find the people interested and qualified in carrying on a particular field of work. Therefore, you are somewhat in the position of placing bets on their success and hoping you will get results. Some results will be exceedingly important, but you cannot guarantee results for any particular effort at any particular time.

I would like to impress on the committee as a matter of my judgment that although sometimes fundamental research results very promptly in results of practical interest, very frequently it is a pretty slow operation—sometimes quite surprisingly slow. I am thinking now of hybrid corn, which is of very fundamental importance to this and other countries. I think the original work of crossing hybrids goes back to 1910 in the Connecticut experiment station. It was only in the middle thirties that it really began to work. With pressure, a great many things can be converted into practical results, and I have no doubt, as far as the defense aspects and interest in this work are concerned, pressure will be available. Nevertheless, the approach to this particular effort is the long-run interest of the country; not the quick-run, short-operation results.

The next thing I would like to call attention to is the importance of maintaining a pool of competent people. If you are going to find out in the time you need to have these projects, you have to have people trained for them and people who are active in them. The only way they can be active in them is by currently engaging in scientific research.

In the nature of the case at any time there are many gaps in scientific knowledge and scientific research that is going on. To what extent the National Science Foundation can help to see that currently important gaps are being worked on I think is a matter that can be determined by experience, because it is not feasible to get a great deal of work done by mere direction.

Finally, I would say to you that in the long run the world problem of this country in connection with this great effort is as to the element of the supply of manpower that is interested, qualified, and equipped to undertake scientific and technical work which the country requires. This civilization, particularly in this country, has become so highly technical that we are going in the future to be dependent upon the volume of men fitted for this kind of work. And that is going to depend on the quality of secondary education and finally college education.

MR. THOMAS: Let me ask you one question. You put your finger on it as your main problem; that is getting prepared and having not only trained men but men actually working in the scientific field as the body of manpower. The question is: How are we going to get it, and who is going to pay for it? Should the federal government pay for it?

DR. BARNARD: Yes; I think we should pay for most of it. We never will pay for all of it, and do not need to pay for all of it. But on the scale that the future calls for, I doubt very much if anybody but the federal government will have either the resources or the fundamental interest to do it.

Let me give you a concrete illustration. If there is anything of interest to this country, it is the production of wheats that will resist rust. We are now facing the danger of rust sweeping through the wheat country from some source arising in New York State. The Rockefeller Foundation, working in Mexico on the Mexican problem, has developed a rust-resistant wheat which might be of great importance to this whole nation. It is not a local proposition.

You have to support talent where you can get it, and I do not think we can rely on local or merely philanthropic resources to do it. In the ultimate, the maximum you are going to be able to spend on this kind of effort by the government is going to be a very small proportion of the total cost of government. But that is going to be due to the bottleneck in men rather than the need and opportunity for work.

MR. THOMAS: You said we not only need manpower, men scientifically trained and engaged in science—and I doubt whether there will be any disagreement with that statement—but your next statement was that the federal government is going to have to pay for it. From the practical angle, that is going to be the answer. That leads to this thought. Of course, we realize this Act does not give to the

National Science Foundation any authority to engage in research itself, but now the federal government has many, many irons in the fire affecting this field one way or the other in the way of subsidies, not only for the training of scientists but for carrying on specific research projects.

The Navy has a program; the National Advisory Committee for Aeronautics has a program; The Atomic Energy Commission and several others that I could mention have programs. Is it advisable to leave those programs as they are, each one going its own way, or should they be consolidated under one head and, if so, is the National Science Foundation the spot to put it in, where the activities can be more or less correlated with the idea of holding down, if possible, the cost and certainly to have some degree of coordination in the efforts of everybody?

Instead of having everybody working all over the lot and throwing balls in every direction, let us have somebody calling the signals and hoping that at least we will have a firm basis upon which to work. Whether we get results today or tomorrow or ten years from now is another question. That is more or less faith in the program. We have faith in the program; we know sooner or later it will pay off; but, during the interim period, it is best to have something of a chart to go by.

DR. BARNARD. I understand the Act really contemplates the kinds of research we are talking about will be done under the direction of this body and will not be dissipated throughout the government. There is some now so done. There is not enough so done, but what there is, is scattered all through the Departments. To get a more sensible and economical coordination of that, that could be handled in this body provided it was an operating body.

NATIONAL SCIENCE POLICY

DR. ALAN T. WATERMAN (Director, National Science Foundation). I would like, if I may, to point out that the three major responsibilities we have are the development of a national science policy, the support of basic research, and the training of scientific manpower. The need for the development of a national science policy cannot be better expressed than was done by the Hoover Commission:

> The major functions (of the National Science Foundation) should be (*a*) to examine the total scientific research effort of the nation; (*b*) to assess the proper role of the federal government in this effort; (*c*) to evaluate the division of research effort among the scientific disciplines and among fields of applied research; and (*d*) to evaluate the key factors that impede the development of an effective national research effort. Based upon its investigations, it should advise the President as to measures necessary to establish a sound scientific program for the nation. In addition, it should advise the President as to the proper balance among research grant and fellowship programs supported by appropriations given to other federal agencies, and as to major policies that should govern the administration of these programs.

The largest item in the 1953 estimate before you is for research support, which amounts to $8,800,000. It is divided equally between biological and medical sciences, and the mathematical, physical, and engineering sciences.

RESEARCH SUPPORT

The distinction between support of research which we have decided to do by grants is a different thing entirely from the fellowship program. In carrying out the support of research, the Foundation will do this by means of grants to nonprofit research institutions for scientific research projects to be performed by special individuals or small groups at the institution.

As you know, the Foundation is not allowed to operate research laboratories. In general, grants are based on proposals by competent investigators which are presented to the Foundation with the endorsement of their institutions.

TRAINING OF SCIENTIFIC MANPOWER

The other major item is the training of scientific manpower, which carries an item of $5,360,000. The major portion of these funds is for the award of graduate fellowships. This is of special importance now because of the demand which is increasing for a supply of trained scientists and engineers. Fellows are selected on the basis of ability only, from applicants who have received a bachelor's degree or the equivalent of a bachelor's degree. The selection is very highly competitive, therefore, and is no respecter of the origin of the application. Any United States citizen who satisfies the requirements may apply. Only in case of substantially equal ability is the Foundation permitted to take into account other factors, such as geographic distribution. The candidates selected for awards are free to enter the graduate school of any accredited institution which will accept them.

President Truman's Endorsement of National Science Foundation—January 15, 1952

> . . . No one can successfully dispute the importance of maintaining and increasing in this country the vitality of the basic research upon which all technological development—and therefore our economic progress and national security—is dependent. . . .
>
> The Foundation is much more than a new executive agency . . . with a research mission. It was conceived as a much-needed keystone in the structure of the national research program. . . . As long as the federal government continues to be the largest factor in the national research effort, it must frankly face the responsibility to ensure that this effort is conceived and executed soundly and effectively.
>
> The results to be obtained from the operation of the Foundation far outweigh its cost. The Foundation's annual budget represents no more than a small fraction of the annual federal outlays for research and development. The funds involved represent a long-term investment in the national security no less than the funds presently being invested in the expansion of productive capacity to carry us through a long period of partial mobilization.
>
> —Letter covering transmittal to Congress of Annual Report of National Science Foundation for 1951

TABLE 1

1953 BUDGET SUBMITTED BY NATIONAL SCIENCE FOUNDATION

Activity	1951 actual	1952 estimate	1953 estimate	Increase, 1953 over 1952
I. Research policy development, and services:				
Development of national science policy	0	$ 50,000	$ 100,000	$ 50,000
Dissemination of scientific information	0	200,000	200,000	0
Maintenance of National Scientific Register	0	125,000	135,000	10,000
Support of Interdepartmental Committee on Scientific Research and Development	$ 26,072	25,000	25,000	0
Related operating costs	49,391	270,000	375,000	105,000
Subtotal	75,463	670,000	835,000	165,000
II. Research support	0	570,000	4,115,000	3,545,000
Mathematical, physical, and engineering sciences	0	570,000	4,115,000	3,545,000
Related operating costs	53,472	290,000	570,000	280,000
Subtotal	53,472	1,430,000	8,000,000	7,370,000
III. Training of scientific manpower:				
Graduate fellowships	0	1,275,000	5,125,000	3,850,000
Research education in the sciences	0	0	100,000	100,000
Related operating costs	21,993	125,000	140,000	15,000
Subtotal	21,993	1,400,000	5,365,000	3,965,000
Total	150,928	3,500,000	15,000,000	11,500,000
Estimated savings	74,072	0	0	0
Total appropriation or estimate	$225,000	$3,500,000	$15,000,000	$11,500,000

SCIENTIFIC INFORMATION

One of the most significant aids to the whole effort of science is the dissemination and exchange of scientific information. The volume of current scientific literature, the demands made on scientific journals for publication of research, and the volume of government and contractors' reports are so large that it is very important that methods be found of classifying this material, abstracting it, and making sure in the end that each research investigator gets promptly the material in the country which he needs.

BIOLOGICAL AND MEDICAL SCIENCES

DR. JOHN FIELD (Assistant Director for Biological and Medical Sciences). Facts and figures from current operations indicate that the $4,115,000 requested will only partly meet the need for the support of basic scientific research in the biological and medical sciences for fiscal year 1953. While requests for support came in slowly at first, due to our necessarily late start, the dollar value of such requests averaged about $500,000 during November and December. It is now rising. For the first ten days of this calendar year, the rate was rapidly approaching $1,000,000 a month in requests.

The requests now in hand came from 73 institutions throughout the land. Forty of these are private universities or colleges; 31 are public institutions, and two are national nonprofit organizations. All sections of the country are well represented except some Rocky Mountain States.

An interesting example of the type of research we sponsor is photosynthesis. This is the process by which plants trap solar energy and store it as chemical energy. Sunlight is the only external energy which continuously reaches the earth in significant amounts. No theoretical restrictions stand in the way of fairly complete conversion of light into chemical, mechanical, or electrical energy. However, such conversion requires a mechanism able to intervene at the instant the light strikes an absorbing surface and thus prevent this energy from being lost as heat. Man has not solved this engineering problem, but the green plants have, and man would not be here today unless they had done this long ago.

Photosynthesis is the ultimate source of all food and fuel. The over-all efficiency of photosynthesis is low. Only about 1 per cent of the light energy falling on the land is now trapped by plants. There is good reason to believe that the efficiency of this process can be sharply increased. Each 1 per cent rise would, in effect, double the area of arable land. We propose to support the pioneering work necessary if this is to be done. Basic research is always essentially a matter of pioneering.

Within broad fields we propose to support research without specific direction and without interference with the scientists. Like love, basic research cannot be demanded or bought. However, I think it is fair to say that money can smooth the path of both.

MR. THOMAS. It does not hurt any; does it?

DR. FIELD. It does not hurt any; it helps much.

MATHEMATICAL, PHYSICAL, AND ENGINEERING SCIENCES

DR. PAUL E. KLOPSTEG (Assistant Director for Mathematical, Physical, and Engineering Sciences). For the numerous fields in my division we ask $4,155,000. I might say the pattern of the Division of Mathematical, Physical, and Engineering Sciences is very similar to that in biological sciences in that the rate of incoming proposals is increasing rapidly and that the total to be expected for the fiscal year 1953 very greatly exceeds the amount we ask. These fields represent unlimited opportunities for basic research. Upon their cultivation our economic future largely depends. Our national security—indeed, our national existence—depends on the success with which we explore them. To neglect this would be like drawing on an account without making deposits. There can be no overdraft when the medium of deposit is scientific knowledge derived from basic research.

As an interesting example of what is coming in, there are several from different sources relating to precipitation from clouds. As you know, this can be very important, for if research can point the way to making a particular cloud formation shed its water on one particular area or prevent its happening over another, there will be at hand a substantial addition to our agricultural resources. Before precise, practical applications can be developed, much more research on a wide scale is needed in mathematics, physics, and the earth sciences. Among our jobs is that of studying such proposals, with the help of competent specialists, to make sure that they properly fit an over-all program.

Another illustration, which I cite merely as a related problem on which we shall probably receive proposals, is the exploitation of the unlimited reservoir of the oceans as a source of fresh water on such a scale that it might be used for irrigation as well as in large centers of population. This would involve not only getting the salt out of the water but also putting the water wherever it may be needed. Is it feasible to transport it from seaside to dry plains many miles away, at high elevations, such as we have in our western states? Offhand, the answer is no, on account of the great cost of trans-

port. However, just because we can't at the moment see the possibility is no proof that it can't be done. We haven't the answer because more research is needed. It could be that this problem is one segment of the problem of putting energy from the sun to work. Maybe a scheme is possible by which the sun may be made to transport water through conduits instead of by way of the clouds.

An incidental asset of great value in the National Science Foundation is the staff of competent specialists who are available for advisory service to other government agencies and to members of the Congress. With accumulating experience, the value will increase.

Through personal contacts of staff members with scientists throughout the country, there is being developed much interest in new possibilities in the research fields. There is evident stimulation of research workers to become more productive in their efforts. The interest and good will of the scientists are important resources to be developed for the nation's benefit. This, too, is our job.

Its [the Foundation's] possibilities are limited only by our imagination and initiative and by the support we receive. A statutory agency such as this is a new concept in statecraft. Managed skillfully, with adequate resources, it will prove over and over again the wisdom of the Congress and the President in creating the law by which the National Science Foundation came into being.

MR. THOMAS. Doctor, you are not only a fine scientist, but you are also a very convincing speaker.

TRAINING OF SCIENTIFIC MANPOWER

DR. HARRY C. KELLY (Assistant Director for Scientific Personnel and Education). Advances in science and technology and the development of industrial and military applications of science will depend on the number and quality of scientists and engineers capable of creative independent research and development. The critical nature of our supply of men was recently given by Defense Mobilizer Charles Wilson, who stated: "The supply of scientific and engineering graduates in 1951 is less than half that needed to fully man our economic and defense programs."

Our request for funds for a continued and expanded fellowship program reflects the widespread conviction that our government has a responsibility to make some effort to reverse current and future trends toward a dangerously decreasing supply of persons trained in these fields during a period when an increasing supply is so vitally needed.

There are seven applicants for each fellowship announced. Applications have been received from every state in the Union, the District of Columbia, Hawaii, Alaska, and Puerto Rico.

Since the transition from undergraduate college to graduate work is the point at which we have traditionally lost many capable scientists, greatest emphasis in our fellowship program is being given to the first year of graduate study. In fiscal year 1953 we have plans for 1,400 first-year fellowships, 500 second-year fellowships, 220 third-year fellowships, and 100 postdoctoral fellowships.

The Foundation intends to initiate a small pilot program in research education in order to give teachers an opportunity of keeping abreast of their fields and to increase their competence as trainers of men.

DR. DETLEV W. BRONK (Chairman of the Executive Committee, National Science Board). I am impressed by the need for exploratory research of the sort you have heard described here this morning as a source of information that can be applied in the development of new weapons and in the design of our strategic and tactical operations. As long as we are going to be required by the necessities of the international situation to expend the vast amount of money that we are required to spend, I believe it is an insurance against the misexpenditure of those funds to have an adequate supply of basic information that provides the source of ideas that can be used in the design of new weapons and continual improvement in existing ones.

I am also impressed by the fact there are large amounts of money spent by the government and by industry on what might be described as developmental research and the application of scientific knowledge. The effectiveness of those expenditures, I believe, will depend on the pool of

TABLE 2

RESEARCH AND DEVELOPMENT IN THE FEDERAL GOVERNMENT
ESTIMATED OBLIGATIONS AND EXPENDITURES,
1953 BUDGET

(Summary of total amounts including construction of facilities)

(In thousands)

	Obligations			Expenditures		
	1951 actual	1952 estimate	1953 estimate	1951 actual	1952 estimate	1953 estimate
	By Department and Agency					
Atomic Energy Commission	$ 284,864	$ 341,898	$ 264,688	$ 249,017	$ 349,469	$ 338,928
Federal Civil Defense Administration	1,042	2,093	4,910	43	891	4,500
Federal Communications Commission	206	190	215	193	180	201
Federal Security Agency	51,932	61,462	45,257	53,373	75,015	62,414
General Services Administration	83	71	.....	143	128	.....
Housing and Home Finance Agency	787	200	340	379	462	376
National Advisory Committee for Aeronautics	84,400	99,897	84,256	61,587	69,438	76,530
National Science Foundation	**151**	**2,150**	**9,735**	**74**	**1,100**	**3,350**
Reconstruction Finance Corporation	6,167	8,840	8,675	6,167	8,840	8,675
Smithsonian Institution	268	267	267	255	254	253
Tennessee Valley Authority	19,523	18,834	18,865	5,573	4,210	4,061
Veterans' Administration	5,071	4,513	5,100	4,585	4,579	4,781
Department of Agriculture	51,079	51,664	52,548	50,310	51,787	52,118
Department of Commerce	13,597	16,504	12,874	16,876	20,263	16,045
Department of Defense, military functions:						
Department of the Air Force	518,308	755,346	747,500*	344,939	523,000	680,000*
Department of the Army	340,806	593,164	554,979*	198,315	355,200	455,280*
Department of the Navy	546,576	667,624	673,649*	420,816	500,000	618,000*
Office of the Secretary of Defense	1,905	82,315	62,006*	1,830	11,900	42,000*
Total military functions	1,407,594	2,098,499	2,038,134*	965,900	1,390,100	1,795,280*
Department of Defense, civil functions	2,300	2,000	2,000	2,300	2,000	2,000
Department of the Interior	33,990	30,447	38,873	32,057	36,794	38,819
Department of State	537	63	1,500	472	83	1,243
Treasury Department	528	503	653	374	599	453
Grand total	1,964,120	2,750,035	2,588,890*	1,449,678	2,016,194	2,410,027*
	By Type of Cost					
Research and development operations, all agencies	1,630,736	2,208,665	2,348,511	1,233,787	1,616,199	1,987,895
Construction of facilities, all agencies	333,384	541,370	240,379*	215,891	399,995	422,132*
Grand total	$1,964,120	$2,740,035	$2,588,890*	$1,499,678	$2,016,194	$2,410,027*

* Additional amounts for construction of facilities may be recommended in anticipated 1953 supplemental estimates included in the 1953 budget for the Department of Defense.

scientific knowledge we have and also on the pool of adequately trained manpower of which Dr. Kelly has just spoken, for it is this pool of manpower that is the source of new ideas.

Finally, as one who is responsible for what I like to think of as a great hospital and great medical center, I am likewise impressed by the tremendous value of this pool of new ideas as the source of information that can be applied in the clinics and in the operating rooms.

JUSTIFICATION OF ESTIMATES

MR. THOMAS. You have an appropriation for the fiscal year 1952 of $3,500,000, and you seek an increase to $15,000,000 for 1953.

[Here the Committee enquired into the costs of personnel, asked for a breakdown by fields of the costs in medical and biological sciences, and a list of the institutions where research contracts were contemplated, with an indication of their location.]

GRADUATE FELLOWSHIPS

MR. THOMAS. Your total cost for the fellowship program is $5,125,000. That is for the fiscal year 1953. The stipend for the first year, let it be noted, is $1,400, plus travel of $50 and average tuition of $500, making a total of $1,950. For the second-year student it is $1,600 with a family allowance of $250, a travel allowance of $80, and average tuition of $500, making a total of $2,430, going on to the postdoctoral with a stipend of $3,000, family allowance $350, travel allowance $400, and tuition $500, making a total of $4,400 for each of the 100.

Referring to those 2,220 young men you are selecting, Doctor, you gave us a rough idea about that a while ago. That is a very difficult job. You will grade the papers of those men, but you cannot put down on paper a lot of the qualities that are really going to make good scientists, so you are going to have to do the best you can. You are going to overlook some good bets.

AFFIDAVIT AND OATH

MR. THOMAS. We have had a little experience with our friends over in the Atomic Energy Commission and some of these young Communist boys. Now, this is a little touchy subject. You might just as well face it because if you do not face it now you are going to have to face it later. The Atomic Energy Commission did not want to put on limitations as to political beliefs, and so forth, purely on the old scientific idea that a man's political thinking is apart and should not be mixed up. But things just do not work that way. So finally, against the will of the Atomic Energy Commission, we just had to write some limitations in the bill. Now, we hope that you gentlemen can handle this matter in your own way. The American people are not going to tolerate your spending money to send some of these Communist boys to school. I do not care how smart they are. We all understand each other now. Take this in in the beginning and act accordingly.

DR. WATERMAN. We have a statement, Mr. Chairman, which the candidates are all required to sign before acceptance of a fellowship.

MR. THOMAS. Fine; read that to us.

DR. WATERMAN (reading);

1. I will bear true faith and allegiance to the United States of America and will support and defend the Constitution and laws of the United States against all its enemies, foreign and domestic.

2. I do not believe in, and am not a member of and do not support any organization that believes in or teaches, the overthrow of the United States Government by force or violence or by any illegal or unconstitutional methods.

[In the discussion following this, the Committee complained that "operating cost is eating up too much of your money," questioned the increase in the item "development of national science policy" and the amount requested for the Scientific Register.]

SCOPE OF PROGRAM

MR. YATES. All of the agencies of the government are spending in excess of two and one-half billion dollars on various research projects. Could it be the function of the National Science Foundation to undertake an inventory of the projects to determine whether or not there is duplication and to channel research with a logical sequence?

DR. WATERMAN. That is one phase of it. This should really be done in two steps. The fastest way of making an inventory in research is to take research men who have specialized in a given field and who know what is going on in research from the standpoint of science. Next a survey of what the agencies are already doing in research and their aims in doing it gives the second phase you speak of since by comparing the two we will know whether the areas of greatest promise are being applied in the proper locations and where there should be more training, also in what areas there should be more, or less, research going on and bring these immediately to the attention of the agencies concerned.

In basic research, as I said a little earlier, the most important thing is the knowledge on everyone's part of what is going on and what the others are doing in his area. Each must do original work and follow through. If there is needless repetition, if unnecessarily they do what somebody else has done or is doing, their scientific reputation suffers.

MR. YATES. Would you think that would be desirable? The thought occurs to me that there is doubt as to whether the agencies will cooperate in the supervision of their projects by the National Science Foundation. Have you found a desire to cooperate?

DR. WATERMAN. Basic research seldom has any security label on it, with certain exceptions, At the same time, when industry does basic research, it seldom has a company confidential label on it. So, it is relatively easy to get cooperation in basic research. People must know what they are doing to get on with it, and must know all available facts. We have not had any trouble on that score so far.

MR. YATES. I think one of the most important things that has been lacking with the government's research program is the failure to disseminate in-

formation on projects that have been completed. I know a businessman who came to see me in connection with his business. He was very much interested in certain work the government had done in the field of radiant color. He could not get any information about it, although the government had been doing research in that field. To the best of my knowledge it was not a classified project. What is the government doing now by way of dissemination of that information? Is it doing anything at all to your knowledge?

DR. WATERMAN. Yes, indeed, it is. We have had this under active discussion with the Library of Congress, which already has a science research section working in cooperation with the Office of Naval Research. It has as its mission the classification and cataloging of scientific projects in the Department of Defense and the dissemination of information. It is a source to which accredited people may go who wish information concerning reports, documents, and other materials. We expect to expand this type of service.

The Department of Defense also has a comprehensive system which is being set up to deal with this same problem.

EXTENT OF GOVERNMENT RESEARCH

MR. PHILLIPS. One of the problems before this committee, about which the chairman has already asked you, is the extent of research work in the government. The list I have here, from the Bureau of the Budget, shows a list of twenty-two agencies and departments of the government engaged in research.

I think what concerns this committee is the possibility of duplication and unnecessary expenditure of money

MR. ANDREWS. What is the total cost, Mr. Phillips?

MR. PHILLIPS. The total shown here is estimated for 1952 at $2,500,000,000. Has there been any effort made by you, before engaging in new research and development and expenditures, to do something about limiting any of the research work done in other agencies, or analyzing it?

DR. WATERMAN. Yes, indeed. We are familiar with their programs, and in the receipt of our proposals, as you may have gathered from earlier remarks, we will always check to find out what other agencies are doing with respect to a given proposal which is coming in.

MR. PHILLIPS. What assurance can this subcommittee get, and from where would we get it, that there is no duplication, and that there are no unnecessary expenditures being made at a time when we are running into a heavy deficit?

[Dr. Waterman here pointed out that the Foundation's request for increased funds for research support had been reflected in the basic research budgets of other departments. Actually $7 million have been cut from the research requests of the Department of Defense, AEC, and other agencies, to compensate for the increased request by NSF.]

MR. PHILLIPS. The first witness testified as to the need of scientific research and gave two illustrations which may not have been the happiest ones to use. He gave hybrid corn for one, and rust in wheat for the other. Hybrid corn is probably the outstanding result of research in this generation, I suppose, in the agricultural field, but it seems to be the only one anybody uses for the purpose of illustration. This is the third time that has been used as the one outstanding evidence of research within a week, and I do not believe the federal government had anything to do with it.

DR. BARNARD. The reason I happen to give it is because it reflects what can be done—

MR. PHILLIPS. You are trying to convince us that the federal government should spend more money on research.

DR. BARNARD. Your statement convinces me that the federal government should be spending more money on it.

MR. PHILLIPS. And you want further investigation into rust-resistant wheat.

DR. WATERMAN. A discovery like that goes back into basic research genetics; it goes back to fundamentals. That is where it is done.

MR. PHILLIPS. We have been developing rust-resistant wheat for fifteen or twenty years, and it was Russia which did the basic research on it, on both cold-resistant and rust-resistant wheat.

DR. WATERMAN. The thing is that if you can succeed in having more basic research genetics you will have more of this type of important research.

MR. PHILLIPS. You see, what you are trying to convince this subcommittee is that the federal government for the first time in its history can do something like this more cheaply and more satisfactorily than private agencies or colleges can. Do you not think every land-grant college in the United States and every agricultural college is working on both rust-resistant wheat investigation and on other matters similar to hybrid corn?

DR. WATERMAN. That is very true, and this goes back to one of my earlier remarks, that the government agencies with their special missions, such as the Department of Agriculture, are trying to produce practical results, and this gets them and others back into the area of basic research by which their efforts are directed toward a given goal. In the history of science some of the most important discoveries have come where you did not know what you were going to find.

MR. PHILLIPS. We are on sort of a type of fishing expedition?

DR. WATERMAN. It has been called a gamble sometimes. It is more like an investment.

(Continued on next page)

Senate Appropriations Committee Members

The only hope for the salvage of the National Science Foundation's appropriation now rests with the Senate Appropriations Committee, which will hold hearings soon. The membership of this committee is as follows:

KENNETH MCKELLAR (D., Tenn.), *Committee chairman*
JOSEPH C. O'MAHONEY (D., Wyo.), *Subcommittee chairman*
STYLES BRIDGES (R., N. H.)
GUY CORDON (R., Ore.)
ALLEN J. ELLENDER, SR. (D., La.)
HOMER FERGUSON (R., Mich.)
LISTER HILL (D., Ala.)
BURNET R. MAYBANK (D., S.C.)
A. WILLIS ROBERTSON (D., Va.)
LEVERETT SALTONSTALL (R., Mass.)
EDWARD J. THYE (R., Minn.)

[The Committee at this point went into the questions of the expense of the NSF General Counsel's Office, suggesting that four employees here were an overload. Mr. Phillips thought that the salary classifications were high and complained that "there were a lot of chiefs for the number of Indians."]

DUPLICATION IN GOVERNMENT RESEARCH

MR. COTTON. Doctor, you have two or three times mentioned the report of your Commission, and that in that report you cataloged to some extent the research activities of the government. In that report did you at any point make any recommendation about the curtailing of any research activity to avoid duplication or unnecessary expenditure of public funds?

DR. WATERMAN. Of course, this report is based on the fiscal year 1951 and makes no specific recommendations. I can only say that the general point of view is expressed that the special purpose of the research which is associated with the mission of an agency should be appropriate and the research sound. The Foundation is not attempting to take a monopoly on basic research, but it is research in the general interest which the Foundation stands for.

MR. COTTON. Doctor, all I wanted to say was this, that it must be obvious to every one of you gentlemen in view of the fact that the chairman has gone into it, Mr. Yates has gone into it, and Mr. Phillips has gone into it, that one thing is very much in the minds of this committee. Speaking for myself, if I remain on this committee I want to be a friend of your agency. I recognized its importance when the bill was passed through Congress that established or created the National Science Foundation. At that time two arguments were advanced that caused Congress to create this organization. One was that we needed an organization to engage in basic research.

Now, the other point was that we needed an agency or an organization that would coordinate, clarify, organize, and prevent waste and duplication in the researches of this government. That was one of the appealing arguments that were made. This subcommittee has occasion to deal with many scientists. They come here in connection with the National Advisory Committee for Aeronautics, the Atomic Energy Commission, and many other agencies. The Federal Communications Commission, for instance, talks about their studies in dividing up the spectrum. In all these other various branches we run into these scientists. Sometimes they have a little tendency to regard us as being a little hard to make understand what they are saying. One of them told us last year that we were not competent to try to coordinate their efforts and to say that this group is doing too much or this group is doing too little and, perhaps, they were right in that statement.

Now, if an eminent body of scientists familiar with this field is going to assist the President, the Congress, and this committee in an effort to restrain, clarify, and coordinate all of these activities then, surely, you are going to justify your work here 100-fold even in addition to this basic research of which you speak, and you are going to have many friends behind this table. However, I cannot conceive of one scientist ever saying that another scientist's appropriation should be curtailed. I cannot conceive how this report, which is new this year, will come along next year and the year after saying that there is some unnecessary work going on in the Department of Agriculture, the land-grant colleges, or the National Advisory Committee on Aeronautics. I am just wondering if you really think that with your funds you will come up with a research and development policy. Are you merely going to list these things and pass over real duplications, or are you going to formulate a national policy actually, even if it cuts, and try to help us to spend money wisely in our research, both in basic research and in the other types? What do you say about that?

DR. WATERMAN. We feel that is our responsibility. It is our job to evaluate research in science and evaluate what the particular agencies are doing in research and as a result of that come up with a national policy which would eliminate unnecessary duplication.

MR. PHILLIPS. Will you be in a position to do that in the next fiscal year?

DR. WATERMAN. I believe that we can make good progress in that direction.

MR. COTTON. Do you predict next year when you come in here that in your report there may be something that would actually lead to certain economies in our general research field?

DR. WATERMAN. I would certainly hope so, yes.

COCKCROFT: PURE SCIENCE

(*Continued from page 103*)

for its use and made representations to Mr. Stimson, Secretary of State for War.

Mr. Stimson has given an account in *Foreign Affairs* of the reasons which led him to recommend the use of the weapon against Japan. Mr. Stimson was one of the great war political leaders and his opinions are entitled to respect. The final verdict as to whether he was right rests with history. If, then, we can sum up the position of British and Allied scientists in this period I would claim that they have acted with a full sense of their responsibility to their country and to world civilization.

POSTWAR PERIOD

If now we turn to the postwar world we have been faced with the development of a threat to the freedom of human society very similar to that presented by Hitlerism at its peak, differing mainly by the element of madness in Hitler being replaced by a more realistic and calculated policy. This type of society is fundamentally different in spirit from societies based on individual freedom and respect for human personality—societies which derive their values from the Greeks and from Christianity.

Our governments have had to decide whether to allow this new form of society to spread through the world or to resist it. We have chosen the policy of containment by strength. As an essential part of that policy we have had to rearm, and in particular the United States has pressed on with its program of atomic armament. Scientists, therefore, have again had to make a choice, whether or not to accept the policy of their government and to work for it. Those who read the *Bulletin of the Atomic Scientists* found this policy debated at length with a very full sense of social responsibility. Scientists have had the freedom of choice, whether or not to work for the policy of their government, and most of them have made their choice. If you asked a typical scientist what he thought was likely to be the outcome, he would probably reply that he was hopeful that the policy of containment by strength would succeed, that the overwhelming power of the West, which is already well on the way to achievement, will make a world war impossible and the counsels of reason be listened to once again in world affairs.

A QUAKER VIEW OF AMERICAN FOREIGN POLICY

A Summary of *Steps to Peace*

Prepared by WILLIAM B. EDGERTON

"Is there no answer to coercive communism other than coercive militarism? God forbid!"

This is the question and the answer which introduces the very provocative publication of the American Friends Service Committee called "Steps to Peace." The version which follows has been condensed to about a third of its original length by William B. Edgerton, a member of the committee which prepared it.

The American Friends Service Committee, as most Bulletin readers know, was founded by the Society of Friends or "Quakers," and is universally respected for its work in promoting social welfare and alleviating social tensions. In this report, which has been widely discussed and debated, the Quakers state that there is another answer besides "coercive militarism"—"an answer consistent at once with the law of God and the precepts of Democracy." They say, "it is neither a simple nor an easy answer. It is not an answer which calls for peace at any price. It calls for peace at a very high price."

AMERICANS have a rich heritage of moral and political principles that are rooted in a belief in the dignity and supreme worth of every individual human being. A love of freedom, a practical realization of the importance of a material standard of living consistent with human dignity, and a deep desire for peace, justice, and security under law—all these are principles that the American tradition at its best has always conceived as applying equally to the whole of mankind.

Fear of Russian imperialism, abhorrence of totalitarianism, and disillusionment over the failure of the Second World War to implement these basic principles, have led the United States to embark on a vast rearmament program designed to protect our own security and that of the noncommunist world. Even though America's motive in formulating this policy has been to promote peace and security, we need to examine and evaluate the results measured against the basic aims of the American people.

Is our present policy winning for us the friendship and confidence of other peoples and nations around the world? To the casual observer the consistent majorities supporting the United States' proposals in the United Nations would seem to indicate that it is. We are inclined to overlook the hard fact, however, that other nations are showing more and more independence of spirit and more and more reluctance to follow American leadership. For example, in the United Nations vote on Chinese aggression in Korea, the United States got a seemingly overwhelming vote of confidence by a count of 44 to 7, and yet in terms of population the 44 votes in favor of the American proposal represent approximately the same number of human beings as are represented by the 7 opposing votes. European votes were given us only with great reluctance and under the strongest pressure. We got no significant support of any kind from Asia. Americans would do well not to attribute this opposition to mere cowardice or lack of moral stamina, for the multitudes who questioned the wisdom of our policy are seeking peace as earnestly as ourselves, and some of them may be in a better position to evaluate all the factors in the situation than we are.

Is our policy advancing the cause of human freedom and welfare? To the two-thirds of the human race who are still submerged in a basic struggle against hunger, poverty, and disease, freedom has largely an economic meaning: freedom from antiquated system of land holding or taxation, freedom from the crushing effects of poverty. They have had little opportunity to know the meaning of political freedom, and communism is attractive largely because it talks in the economic terms they can understand. To these multitudes our policy of military containment does not mean freedom; it often means the maintenance of an unpopular status quo, and at times the outbreak of catastrophic violence which instead of freeing, destroys completely. The tragedy of Korea is that in the vigorous effort to vindicate a principle, the Korean people themselves have been the losers, whatever the military outcome.

Even at home our foreign policy is resulting in the restriction of freedom rather than its growth. All-out preparedness, such as our world-wide military containment policy demands, must inevitably be accompanied by conscription, regimentation, high taxes, pressure for conformity, government controls, and loss of individual freedom. More and more, in the hope that our might can prevail, we are forced to make ourselves over in the image of those we oppose.

Does military containment give promise of providing us and other nations with a measure of security? If ever weapons and power can give security, the United States should feel secure at present, with the highest level of armaments in our peacetime history. And yet, despite our geographical position, our industrial strength, our navy, our stockpile of atomic weapons, and our facilities for producing more, evidence points to the fact that we have felt more insecure since the end of World War II than at any time within memory. Can it be that our almost exclusive concentration on armaments as a means of meeting the threat of communism is itself contributing to our insecurity and to the insecurity of the world? In

the realm of arms one nation's common sense is another nation's high blood pressure. In seeking to deter the Russians purely by military might we are inevitably forced to plunge the world into an arms race, and arms races are not conducive to security.

A great danger lies in our continuing to make the assumption that a policy of containment which virtually challenges Russia to a test of military strength is actually a policy for building peace. Although sincerely conceived as such by our military planners, the writers of *Steps to Peace* are convinced that it is not. Peace and security can best be achieved by an imaginative, creative foreign policy in which military planning is not predominant, as at present, but is subordinated to a program that will give the poverty-stricken two-thirds of mankind hope in something other than communist violence as a solution to their problems.

WHY HAS OUR POLICY FAILED?

Our policy in Asia has failed to lead us to the real objectives of the American people because its preoccupation with strategy and ideology has prevented our giving sufficient weight to the economic, social, and political realities of Asia. There, as elsewhere, we have tended to label as communist any movement that sought a radical change in the established order, without consideration of the roots of such a movement. The great, overriding fact of Asia is poverty. Poverty has always bred violence sooner or later and will continue to do so wherever it exists. The people of Asia would have adopted a radical solution to their urgent economic problems even if communism and the Soviet Union had never existed. We must also try to understand Asia's sensitive new nationalism, born of a century of humiliation and exploitation of a proud people by white imperialists. Another factor we too often overlook is the extent to which internal corruption has alienated Asian governments from their peoples. This was particularly true of the Nationalist regime in China, and provided an important reason for the easy successes of the communist armies.

In Europe the great tragedy is that the splendid hopes for genuine economic recovery which were aroused by American aid through UNRRA and the Marshall Plan have now been all but lost to sight in the developing conflict between the United States and Russia. However much Europeans may distrust Soviet intentions and fear the expansion of communist control, they equally abhor the prospect of another war. Correctly or not, many Europeans now believe that the United States is resigned to the inevitability of war with the Soviet Union, and that its policies are primarily directed toward ensuring military victory. Strategic expediency is now having such influence in the formulation of American policy that many Europeans have also come to doubt the sincerity of our insistence that the world struggle is one between freedom and tyranny. Our vigorous intervention on behalf of a strongly rightist Greek government, the increasing warmth of our relations with fascist Spain, and our friendly overtures to communist Yugoslavia seem to indicate that the United States will ally itself with any state that is anti-Russian.

The time is at hand to make new efforts toward a general settlement with the Soviet Union, in order that we can return to a policy which is directed at Europe's needs and Europe's aspirations instead of Europe's military potential. Great as the difficulties are, we believe that a more affirmative and more effective American policy can be developed. Indeed, we believe that many Americans are already in agreement about its general outlines. Let us now turn to an examination of this alternative program.

NEW INITIATIVE FOR PEACEFUL SETTLEMENTS

Negotiation with other governments is a permanent assignment of the American State Department. It must not be defaulted if the people's interests are to be served. Not only should we be prepared to negotiate; we should also be prepared to accept the compromises which are an inevitable part of negotiation. There is nothing wrong with compromise as long as it is honorable. What we need to guard against is the unprincipled effort to make settlements at another's expense.

A substantial block of American opinion rejects negotiation because of discouragement. There is no debate about the difficulty of negotiating with Russia or the fact that up to this point negotiation has not been very fruitful; but before we abandon it altogether it is worth while to see whether failure has been due entirely to Russian blocks or whether it has been partly a result of shortcomings in techniques and procedures of negotiation. The

"Peace Is Inevitable"

"... But the new powers which science has let loose cannot be bottled up again. They must be used for constructive ends or they will break loose in another world war which will destroy our European civilization with all its magnificent achievement.

"For Europe at least peace is inevitable. It can be either the peace of the grave, the peace of the dead empires of the past, which lost their creative spirit and failed to adjust themselves to new conditions, or a new dynamic peace applying science in a great leap forward in the evolution of human society to a new age in which hunger, poverty, and preventable disease will be eliminated from the earth—an age in which the people in every country will rise to a far higher level of intellectual and cultural well-being, an age in which "iron curtains" will disappear, and people, though intensely patriotic for their own country will be able to travel freely as world citizens. That is the hope Science sets before us.

"Let there be less talk of war which inspires fear and panic and more talk of the great age struggling to be born."

—From "Science, Politics and Peace," a lecture delivered by Sir John Boyd Orr on the occasion of the award of the Nobel Peace Prize of 1949

requirements for successful negotiation in domestic affairs are well known; and while it cannot be assumed that what has worked in one kind of situation will necessarily work in another, possibly this domestic experience may throw light on our difficulties in international negotiation. What are these requirements?

1. Negotiation requires a flexible attitude.—Two conflicting points of view can be reconciled only if both sides are prepared to give up nonessentials for the sake of agreement on essentials. Give-and-take is at the very heart of the whole process. In postwar international negotiations, however, both the United States and the Soviet delegations have repeatedly arrived at conferences under firm instructions from their governments regarding the position to be taken on each question, with no latitude given for shifting positions as discussion proceeds. What then takes place cannot be called negotiation at all. It is simply the spirited defense of one's own position and the equally spirited denunciation of any other, followed by mutual charges of bad faith and the break-up of the conference.

All this has led the United States to believe it can negotiate only from "situations of strength," imposing its proposals by force since it cannot get them accepted through persuasion. This technique has been widely approved because the United States sincerely believes its proposals to be fair, but we should realize that it is a dangerous procedure. At one time or another during the Korean conflict the Chinese government and the United States have each had opportunities to negotiate from positions of strength, but neither has been disposed to do so because it seemed that much more could be gained by force through what appeared to be an impending military victory.

2. Negotiation requires an open mind.—Flexibility on one's own position must be matched by a willingness to try to understand other points of view. Here again each of the major protagonists in postwar international negotiations has frequently rejected out of hand any proposal made by the other as being dishonest and insincere, while advancing its own proposals as righteous, generous, and fair. This attitude stifles any attempt to examine a proposal on its merits. India made one notable attempt to break this pattern in the autumn of 1950, when her U.N. delegation suggested the examination of both the American and the Russian resolutions on Korea with a view to finding some basis for a common resolution. This step was in accord with good negotiation procedure. Unfortunately, the Indian resolution was defeated as a result of American pressure against it.

3. Negotiation requires privacy.—Industrial negotiators have long been aware that negotiation cannot always be carried on in a goldfish bowl. When differences are under discussion the representatives of labor and management closet themselves without benefit of press or public. Only the results become public property, to be either accepted or rejected as the constituencies see fit. This technique might well be called one of "open covenants secretly arrived at." Full publication of the results safely distinguishes secret negotiation from the old-style secret diplomacy, in which the agreements themselves are concealed from the public. If such publicity is provided at the end, moral principle and democratic process have the protection they require.

4. Negotiation requires persistence.—Unfortunately, postwar international negotiators have been too persistent in urging a particular agenda or a particular plan, and not persistent enough in exploring new possibilities that might move discussions off dead center. If general settlement of international problems is not possible, diplomats should continually explore the possibilities for piecemeal settlements. Indeed, in problems as complex as those attending present international relations, there may well be areas that are not yet ripe for negotiation, and which should be allowed to continue untouched for the present. Statesmen should be persistent in seeking out and negotiating on those problems where some reasonable hope of success exists. If negotiators become discouraged or exhausted, they should be replaced.

Suspicion and lack of confidence in mutual good faith have grown so great that no one knows to what extent new negotiations with the Soviet Union can succeed. Moreover, even if the United States makes a fresh start, it will still require a new approach on the part of the Russians, whose conduct at the negotiating table has contributed to the present impasse. Nevertheless, we have the responsibility of making the record clear as regards our own conduct. A new spirit in diplomacy by this country undoubtedly would have a greater chance of eliciting more constructive responses from Soviet representatives than have our past tactics.

Possibly the approach that offers the best promise is to attempt negotiation first in those areas where there is a maximum of mutual self-interest in obtaining agreement. Much has been written about the faithlessness of the Soviet Union in living up to its agreements, but the fact is that in an ungoverned world all sovereign states have tended to disregard agreements when they considered it in their self-interest to do so; and this makes the element of self-interest all-important in present negotiations. This conclusion is supported by existing evidence in commercial fields, where Russia has, in general, lived up to her obligations. Trade agreements offer mutual advantages. This suggests that it might be profitable to attempt to reach agreements in other fields where mutual interest in success is most obvious.

THE ESSENTIAL ROLE OF THE UNITED NATIONS

A principal reason for the insertion of the veto in the Charter of the United Nations was to make sure that the organization would not attempt collective action against one of the great powers. It was recognized that such an attempt would almost certainly lead to a major war—and the failure of the United Nations. The expectation was that a United Nations police force would develop in a disarmed world and under a system of recognized laws and restraints. Its presence as a monopoly of force, available for United Nations use, was to deter any country from attempting to settle its international problems by military means.

We are now faced with a very different kind of alternative. In a dangerously armed world, in which the power struggle has reached almost unprecedented proportions, it is suggested that the United Nations still attempt to develop collective military and economic measures that may be used against one or more of the great powers. The belief of the United States that this is a proper line of development for the United Nations has occasioned many misgivings among other members. May not the most important function of the United Nations in an armed world be to serve as an agency of mediation and peaceful settlement? Is it possible to keep this central function uppermost while discussions continue about the collective measures to be taken by the majority against the minority if

and when the political conflict erupts into war? These questions would not take on such persistent form for most delegations in the United Nations if they were not so frequently caught in the struggle between the two great powers, and if the United States did not wield such overwhelming influence in the United Nations majority votes on political matters.

The general intention at San Francisco was that the United Nations should be an inclusive world organization. It was to be the central and universally accepted agency where political conflicts could be resolved and economic and social programs of world-wide importance would be developed. Obviously the world organization has great weaknesses if any substantial number of nations are not admitted to membership. While the long disputes over the fourteen countries now awaiting admittance and over China's representation are in themselves a result of East-West tension, they have also served to aggravate that tension, and have prevented the United Nations from effectively playing its role in peaceful settlement.

How is it possible, during this period before general disarmament agreements have been reached, to strengthen the peace-making functions of the United Nations? We believe the following suggestions are worthy of careful study.

1. Move immediately to admit all applicant nations who express the willingness to accept the responsibilities of membership.

2. Avoid exerting pressure on other countries to accept the position being taken by the United States Government. The United States is a relatively young country. Our foreign policy is subjected in an unusual degree to internal stresses and strains. If some of our hasty and ill-conceived actions in the United Nations have temporarily isolated us from some of those countries with which we have most in common, that should lead us not so much to frustration as to a reflection on the nature of our leadership. Other countries with somewhat more perspective on the power struggle and on ways in which it might be resolved, may frequently have suggestions that it would be in our interest to consider.

3. Make every effort to settle the Korean conflict by negotiation. United Nations experience in Indonesia and Palestine showed the difficulty of getting a cessation of hostilities until both sides gained some assurance that the issues over which they took arms would receive the careful attention of the United Nations Mediation Commission. There is little reason to believe a cease-fire can be achieved in Korea except under similar circumstances.

4. Emphasize and develop the peace-making functions of the Security Council and the General Assembly. This could include:

a) Reviving the procedure adopted some two years ago of having the permanent members of the Security Council meet privately beforehand to see if they can adjust their differing approaches to the questions coming up for discussion.

b) Making use of the Peace Observation Committee established by the General Assembly at its Fifth Session.

c) Exploring ways of securing the services of the ablest and most experienced personnel from member-countries for the mediating and conciliating missions of the United Nations. In this connection more use might be made of the Panel of Inquiry and Conciliation that the General Assembly has already established.

d) Studying the experience in mediation and conciliation in other fields to see what relevance it has for the United Nations.

e) Keeping constantly in mind that the United Nations structure itself, with its councils and commissions, is a most potent continuing instrument of mediation and conciliation in the present armed and divided world.

Does this insistence on strengthening the peace-making instead of the collective security functions of the United Nations mean that it can never become an agency capable of creating and administering world law and order? It does not. We believe, however, that the next steps in an orderly progress in this direction can best be taken by strengthening the peace-making machinery of the United Nations, working out programs for the international control of arms, developing measures to implement the agreements on human rights, and expanding international programs of economic development. These steps will greatly enhance the prestige and effectiveness of the United Nations, which must be strongly supported before major constitutional changes in its structure can be undertaken. Otherwise, the attempt to carry them through could easily result in a disastrous division of the world organization itself. To many this may seem too slow a method for achieving an adequately governed world, but we believe it is the path most likely to lead to lasting results.

DISARMAMENT AND INTERNATIONAL CONTROL OF ARMS

A third element in any alternative program for the achievement of peace is effective disarmament. As long as individual nations engage in a race for supremacy in armaments, efforts to negotiate and to develop the peace-making machinery of the United Nations will be lost in the mounting fear and suspicion that an arms race is bound to produce.

Although Americans are now inclined to despair of the possibility of disarmament, it does not appear that this pessimism is entirely warranted by the facts. Part of it stems from the

"Too Few Men of God"

"We have too many men of science, too few men of God. We have grasped the mystery of the atom and rejected the Sermon on the Mount. . . . The world has achieved brilliance without wisdom, power without conscience. Ours is a world of nuclear giants and ethical infants. We know more about war than we do about peace, more about killing than we do about living."

—General Omar Bradley

widely advertised and inaccurate reports about the failure of previous disarmament efforts, such as the Washington Conference of 1921 and America's supposed disarmament after World War II (which was in reality demobilization, not disarmament). Part of the discouragement stems also from the difficulties of reaching any agreement with the Soviet Union. Nevertheless, there are at least four new elements in the situation that make it worthwhile to consider a new effort by the United States in the field of armament control:

1. The Soviet Union's possession of atomic weapons, which destroys any possibility of security without international control that might have existed when the United States had a monopoly of such weapons.

2. Some concessions, as presented by Mr. Vishinsky on October 23, 1950, in the Soviet proposals on control of atomic energy, which now seem to be moving toward a system of international inspection, to be established *simultaneously* with an agreement to outlaw the use and possession of atomic weapons.

3. The belief of some careful students of the problem that international ownership and management of all atomic facilities—upon which the United States and the Soviet Union have been in continuous deadlock—is not the only satisfactory technical means to prevent atomic energy from being used for military purposes.

4. Willingness of the United States, as evidenced by President Truman's statement of October 24, 1950, to consider atomic and conventional weapons as parts of a single problem of disarmament rather than insisting upon agreement first on atomic control.

The rewards of successful control and reduction of armaments are so great, and the costs of continued deadlock are so high, that the United States should make vigorous and unflagging efforts to explore every possible avenue for agreement.

DEVELOPMENT OF LARGE-SCALE PROGRAMS OF MUTUAL AID

There is no part of the world in which the people do not face the necessity of large-scale and profound changes in their uses of resources, if they are to maintain or improve their standard of living. If these changes are to be effective they must be accompanied by changes also in the system of land ownership, or in local educational programs, or in the whole structure of government by which economic and political power are distributed at the local level. Thus, work of the type undertaken under the Point Four program by the United States cannot be considered merely an application of American agricultural technology or engineering skill to less-developed areas; it becomes, if it is to be fully fruitful, the spearhead of penetrating and pervasive social change. Such change in the long run is inevitable. The problem it presents in country after country is whether it shall be achieved peacefully or by violence.

The writers of *Steps to Peace* regard a world-wide program of mutual aid, properly conceived and executed, as one momentous answer to this problem of violent versus peaceful change. Four major benefits would flow from it. First, it would be a concrete demonstration of those peaceful ways of meeting the needs of society which are available as an alternative to violence. Second, such a program could be a common cause in which nations with different social philosophies might cooperate on a world scale. It is, of course, not certain that the Soviet Union and its associates would take part, since in communist theory any improvement in living conditions is thought of as superficial unless it is preceded by violent revolution; on the other hand, the Soviet block in 1949 voted solidly in favor of the United Nations technical assistance program, so that Soviet abstention is by no means a foregone conclusion. Third, such a program would give the world a concrete demonstration, through deeds, of the value of democratic processes, and would be more effective than the most skillful propaganda in persuading people that there are other ways of meeting human need than the way proclaimed by communism. Finally, an adequate mutual aid program would be much more than a flow of aid from well-off to needy countries. It should stimulate resources of energy and self-help within the country receiving the aid. A case in point is that of El Salvador, in which the offer of a small contribution of supplies from UNICEF for a child-feeding program led to the establishment by El Salvador of a public health service, to a tenfold increase in its budget from domestic sources within three years, and to the training of a staff to carry on a nationwide program of health education.

A program that would produce these results must be internationally administered if mutual aid is to be safeguarded against accusation, grounded or groundless, of "imperialism." Mutual aid programs to be effective must be aimed at meeting needs in the countries aided, not at promoting strategic or business advantages. Increased security, wider markets, and expanded employment opportunities would certainly accrue to the participating countries, but they should come as by-products rather than as the principal objective. Moreover, mutual aid is too large a job for any single nation to undertake. Present American Point Four and United Nations appropriations are insignificant; and only the Colombo Plan for Southeast Asia, launched principally by countries of the British Commonwealth and calling for an investment of five billion dollars over a six-year period, offers opportunity for major undertakings at the present time. What is needed must be even larger, but is not beyond easily practicable limits, especially if armaments agreements open the way to cutting down the biggest non-productive item in our national budget. The cost of economic development is high, but not in relation to the cost of arms.

There is immediate need for a vigorous effort to unite American opinion behind a coherent program of private and governmental action, both national and international, all motivated by a concern for the general welfare and all directed toward developing the resources of the world for the benefit of all the world's people. A nation-wide committee, like the Committee for the Marshall Plan, might be the most useful first step in this direction.

America was brought into being as a nation by men who had a deep sense of the value of the individual, a mistrust of undue influence by men of military mind, and a deep and pervading confidence in God. Now that we are no longer an infant republic but a powerful nation, it is obviously essential that a new responsibility must characterize our public acts. The test will be whether our physical strength will tempt us to depend upon force rather than upon moral and spiritual values. A humility sensitive to how other peoples and governments feel, an inquiring spirit that persistently tries to understand those we fear most, and a continuing recognition that all people everywhere are children of a common Father—these constitute, we believe, a much surer position of strength than one that depends upon overwhelming military supremacy.

UNITED NATIONS ATOMIC ENERGY NEWS

DISARMAMENT NEWS

ELIZABETH STERENBERG

ON OCTOBER 24, 1950, when President Truman made his United Nations Day speech at Lake Success, there had been a deadlock for more than two years on the issue of international control of atomic energy. In an effort to break the deadlock President Truman suggested that the United Nations dissolve the existing Atomic Energy Commission and the Commission on Conventional Armaments and set up a new disarmament commission to consider both conventional and atomic weapons. The Soviet Union had been insisting on such joint consideration for some time, but the United States had until then held out for a separate agreement on atomic energy.

The General Assembly instructed a Committee of Twelve, consisting of representatives of the eleven Security Council members and Canada, to report to the next regular session of the Assembly on the advisability of merging the two Commissions. In the deliberations of this Committee during 1951 the United States succeeded (by a vote of 11:1) in getting its proposals adopted as the basis of the report to the next Assembly. Their insistence that the majority plan, endorsed by the Assembly in 1948, should continue as the basis for future work on the atomic energy aspect of disarmament meant that the United States still advocated international ownership and control of atomic facilities and stockpiles as the only effective method of control.

A ten-day general debate on the state of the world opened the Sixth General Assembly at Paris on November 6, 1951. Fifty-one members participated. A recurrent theme was the desire for a slowing of the arms race in order to ease the burden on weak economies and allow for more spending on economic and social betterment. The disarmament issue was brought to the center of attention on the first day of debate when Dean Acheson outlined the joint proposals of France, the United Kingdom, and the United States for a program of "regulation, limitation, and balanced reduction of all armaments and armed forces," and Andrei Vishinsky submitted a USSR proposal, "Measures to combat the threat of a new world war and to strengthen peace and friendship among nations." Mr. Acheson wanted the discussions on the three-power proposals to begin immediately, although he thought that no disarmament program could actually be put into effect while the United Nations forces were resisting aggression in Korea. The explanation and defense of the two sets of proposals and the following days of general debate showed up clearly the wide area of disagreement still existing.

THREE-POWER PROPOSAL

On November 19 the First Committee took up the three-power draft resolution as the first item on its agenda, the Soviet draft resolution having been placed fifth. The three-power proposal incorporated the Committee of Twelve's recommendation for a single new disarmament commission and proposed that its membership be the same as that of the existing commissions. The task of the new commission would be to prepare proposals to be embodied in a draft treaty or treaties according to the following guiding principles: (1) limitation and balanced reduction to levels adequate for defense but not for aggression, and effective international control to ensure the prohibition of the atomic weapon; (2) progressive disclosure and verification on a continuing basis of all armed forces, including paramilitary, security, and police forces, and all armaments, including atomic weapons; (3) effective international inspection to ensure the adequacy and accuracy of the information disclosed; (4) the United Nations plan for the international control of atomic energy and the prohibition of atomic weapons to continue serving as the basis for the control of atomic energy unless and until a better or no less effective system can be devised; this not to mean, of course, the prejudging of any other plan that may be put forward; (5) an adequate system of safeguards to ensure observance of the disarmament program and provide for the prompt detection of violations without causing more than the minimum interference in the internal life of each country; (6) the treaty (or treaties) to be open to all states for adherence and to be ratified by at least those states whose military resources are so substantial that their absence from the program would endanger it.

ACHESON'S STATEMENT

Mr. Acheson amplified these principles in his statement before the Committee. In the process of disclosure he favored beginning with those areas where there was the least danger to national security, and then, after evidence that the system worked, proceeding to the more secret and sensitive matters. Certain matters relating to atomic energy could be disclosed and verified in the first stage along with all types of armed forces and their conventional armaments. The number of bombs actually fabricated was of less importance than the amount of fissionable material and the rate of production. Atomic energy disclosures, too, should begin with the less sensitive areas such as raw materials, progress through the processing plants, and then deal with the more secret areas until all secret weapons had been disclosed. Mr. Acheson emphasized that the change in the United States position to provide for disclosure of atomic information had been

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made in the hope of facilitating agreement. He said that progress from one stage of disclosure to another could be an administrative matter under the control of the Commission. Verification was more important than disclosure. An international inspection staff would have to be empowered not merely to verify statements but to examine all facts without limitations.

Criteria for the limitation of military forces and for monetary expenditures on armaments could relate to population, national production, and the needs of individual nations under the disarmament program. In order to avoid the danger that a group of nations might combine their resources and concentrate on a certain arm such as bombers or submarines, there was a need to agree on the nature of the armaments and armed forces for the different nations. Information on proposed national programs should be submitted, therefore, and these programs should be scrutinized by the Commission and their implementation inspected by it. Safeguards must apply to all nations and be backed up by international inspection carried out through and by the United Nations. The United States was ready to adjust its views to those of other nations on the issue of whether the procedures for disclosure and verification should be dealt with first and other matters subsequently, or procedures covering the whole field drawn up simultaneously and acted on as a whole.

VISHINSKY'S PROPOSALS

Mr. Vishinsky and the Polish and Czech delegates argued that the three-power plan, in calling for balanced reduction to levels adequate for defense but not for aggression, did not rule out further increases in armaments. It merely conformed to the old Baruch scheme; it did not provide for prohibition of atomic weapons—and control without prohibition would be valueless. The system of stages would permit the postponement of prohibition forever; the United States had always opposed destroying atomic bombs. Mr. Vishinsky was opposed to placing production of atomic energy exclusively within the ownership of the international control organ, for the international character of such an organ might well be unsatisfactory.

As amendments to the three-power draft resolution Mr. Vishinsky submitted the following proposals: (1) prohibition of atomic weapons and of the use of atomic energy for other than peaceful means; (2) a draft convention to this effect to be drawn up by a Commission on Atomic Energy and Conventional Armaments under the Security Council and submitted to the Council for consideration by February 1, 1952; (3) adequate enforcement of these General Assembly decisions within the framework of the Security Council; (4) a one-third reduction of armaments and armed forces by the permanent members of the Security Council; (5) the convocation by June 1, 1952, of a world conference on disarmament.

AREAS OF AGREEMENT AND DISAGREEMENT

After ten days of debate failed to reconcile these opposing views to any great extent, the First Committee unanimously adopted a resolution requesting the great powers to confer privately among themselves in an effort to formulate proposals upon which they could agree. They requested a report by December 10. The president of the General Assembly acted as chairman of the subcommittee, which consisted of representatives of the four great powers. They brought back a unanimous report on December 10, but the best that they could say in their final conclusion was that "despite the disagreements which exist on a number of matters of major importance in the two proposals, it seems clear that there is some agreement on a number of aspects of the two programs."

There was, in fact, a wider area of agreement than before on some procedural matters and on the statement of general objectives, but still fundamental divergence on the basic issues—the principles and methods to be used in achieving these objectives. There was agreement on a single commission for all types of armaments, on the necessity for disclosure, verification, inspections, and safeguards. But the USSR favored simultaneous disclosure of information on both atomic and nonatomic weapons within one month and was absolutely opposed to disclosure by stages. The USSR objected to inspection on a continuing basis, the only method which the three powers considered effective. There appeared a possibility that a formula could be worked out on the question of the veto: the USSR proposed that the control organ should be established "within the framework of the Security Council, but stated that majority decisions of the control organ should be binding on all with no veto right; the United Kingdom suggested that the matter could then be taken care of by properly defining in the treaty the respective functions of the control organ and the Security Council. There was still sharp disagreement on the following items of major importance:

1. *Reduction of armed forces and armaments.*—The USSR still maintained that "levels adequate for defense but not aggression" might mean an increase in armaments rather than a decrease. The three powers opposed the USSR formula of reduction by one-third within one year as likely to preserve or intensify the existing balance; the Soviets claimed that this was the only formula that could end the arms race in the United States.

2. *Order in which prohibition and control should go into effect.*—The three powers insisted that a control system must be set up prior to prohibition of the atomic bomb; the USSR insisted on immediate and unconditional prohibition. Controversy over this point arose more frequently than over any other.

3. *Basis for control of atomic energy.*—The three powers continued to demand the majority plan as the basis for future work on atomic control unless and until a better plan was worked out; the USSR rejected this "same old Baruch plan" absolutely, chiefly on the grounds that international ownership and control would infringe on the sovereignty of nations and lead to a monopolistic trust under the United States, that uncontrolled production of atomic bombs would be legalized, and that prohibition of atomic weapons would be indefinitely postponed. The USSR proposed an international control organ to implement the system of control of atomic energy, with effective international inspection to be carried out in accordance with the decisions of the control organ; the three

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powers rejected reliance on inspection as the only means of control.

A paragraph-by-paragraph examination of the revised tripartite proposal and USSR amendments drew the two sides no closer together on the main issues of disagreement. Attempts by Poland and Czechoslovakia to gain acceptance for resolutions that would leave the new commission free to examine all controversial proposals were defeated. The delegate from Iraq asked Mr. Vishinsky whether the USSR delegation would be willing to cooperate if the USSR amendments were rejected and the tripartite draft resolution adopted. Mr. Vishinsky replied that the USSR delegation was not prepared to accept the three-power proposal as a basis for future work; this did not mean, however, that the USSR would not participate in the work of the proposed commission or any other committee—in the hope that other questions and proposals might lead to the elimination of disagreement.

The tripartite proposal was adopted by a vote of 44:5 with 10 abstentions on December 19, just a month after the First Committee had begun debate on it. The First Committee had never before spent so much time on the first item of its agenda. On January 11 the General Assembly adopted the resolution as recommended by the First Committee by a vote of 42:5 with 7 abstentions. The following excerpts include its most important provisions:

EXCERPTS OF RESOLUTION

The General Assembly . . .

3. *Directs* the Disarmament Commission to prepare proposals to be embodied in a draft treaty (or treaties) for the regulation, limitation, and balanced reduction of all armed forces and all armaments, for the elimination of all major weapons adaptable to mass destruction, and for effective international control of atomic energy, the prohibition of atomic weapons and the use of atomic energy for peaceful purposes only. The Commission shall be guided by the following principles:

a) In a system of guaranteed disarmament there must be progressive disclosure and verification on a continuing basis of all armed forces—including paramilitary, security, and police forces—and all armaments including atomic;

b) Such verification must be based on effective international inspection to ensure the adequacy and accuracy of the information disclosed; this inspection to be carried out in accordance with the decisions of the international control organ (or organs) to be established;

c) The Commission shall be ready to consider any proposals or plans for control that may be put forward involving either conventional armaments or atomic energy. Unless a better or no less effective system is devised, the United Nations plan for the international control of atomic energy and the prohibition of atomic weapons should continue to serve as the basis for the international control of atomic energy to ensure the prohibition of atomic weapons and the use of atomic energy for peaceful purposes only;

d) There must be an adequate system of safeguards to ensure observance of the disarmament program, so as to provide for the prompt detection of violations while at the same time causing the minimum degree of interference in the internal life of each country. . . .

4. *Directs* the Commission, when preparing the proposals referred to in the preceding paragraph, to formulate plans for the establishment within the framework of the Security Council of an international control organ (or organs) to ensure the implementation of the treaty(or treaties). The functions and powers of the control organ (or organs) shall be defined in the treaty which establishes it;

5. *Directs* the Commission, in preparing the proposals in paragraph 3 above, to consider from the outset plans for progressive and continuing disclosure and verification, the implementation of which is recognized as a first and indispensable step in carrying out the disarmament program envisaged in the present resolution;

6. *Directs* the Commission, in working out plans for the regulation, limitation, and balanced reduction of all armed forces and all armaments,

a) To determine how over-all limits and restrictions on all armed forces and all armaments can be calculated and fixed;

b) To consider methods according to which states can agree by negotiation among themselves, under the auspices of the Commission, concerning the determination of the over-all limits and restrictions referred to in subparagraph (*a*) above and the allocation within their respective national military establishments of the permitted national armed forces and armaments. . . .[1]

USSR DRAFT RESOLUTION

But the USSR attempt to have its views included in those to be considered by the Disarmament Commission did not end with the adoption of this resolution. When the USSR draft resolution, "Measures to combat the threat of a new world war and to strengthen peace and friendship among nations," came up before the First Committee, it still included—along with provisions for ending of military operations and for the withdrawal of foreign troops in Korea; for condemning participation in the North Atlantic bloc and the establishment of air bases in foreign territory—the same provisions that had been included in the amendments, though now modified in some instances: (1) unconditional prohibition of atomic weapons and strict international control to enforce such prohibition should be put into effect simultaneously, and a draft convention to be submitted by June 1 should ensure such prohibition as well as the cessation of production of atomic weapons and the use of those already manufactured for civilian purposes only; (2) the permanent members of the Council should reduce their armaments and armed forces by one-third within one year; (3) within one month all states should submit complete official data on their armaments and armed forces, including atomic weapons; (4) within the framework of the Council an international control organ, having the right to conduct inspection on a continuing basis but not to interfere in the domestic affairs of states, should be established to supervise implementation of these decisions and to verify the data submitted by states; (5) not later than July 15, 1952, a world conference of all states, both members and nonmembers, should meet to consider the problem of disarmament.

Speaking for the United States, Mr. Ernest A. Gross said that if the Soviet Union now really meant prohibition and the setting up of a system of control to be simultaneous, this was a step forward from its previous position, but he also noted that the Assembly had rejected a similar proposal as inadequate in 1948. He said, too, that the possible advance in allowing for inspection "on a continuing basis" was nullified by saying that it should not interfere in the domestic affairs of states. The First Committee rejected the items relating to Korea and the North Atlantic bloc, but accepted a three-power counter-resolution to transmit the five proposals relating to disarmament to the new Commission. The Assembly approved this resolution on January 19. Thus the USSR finally succeeded in having its views on disarmament, in this modified form, transmitted to the Disarmament Commission. It is interesting, for the student of international relations at least, to note that even on this resolution

[1] United Nations General Assembly document A/L. 25.

(*Continued on page 126*)

ATOMIC POWER AND REGIONAL DEVELOPMENT

WALTER ISARD and VINCENT WHITNEY

The advent of atomic power may bring about a new industrial revolution. To assess the direct and indirect effects of such a technological change is the task of the economist and sociologist. Will atomic power bring the greatest benefits to the underdeveloped regions, or will it be of most value to the already industrialized countries? A discussion of the techniques available to the sociologist in making such predictions is presented in the following study. Vincent Whitney is Chairman of the Department of Sociology at Brown University; Walter Isard is Research Associate in the Department of Economics, Harvard University. They are the authors of a forthcoming book analyzing the social and economic consequences of atomic power.

ATOMIC development continues apace. True, the great majority of Americans, the authors among them, know about as little of the details of the research and development programs in the United States as they do of whatever is going on in Russia. But careful reading of AEC documents, appropriation requests to the Congress, and even generalized program statements in the daily press make the fact of continuing development perfectly clear.

The sobering side of the picture is found in the implications of the fact that American attention has apparently been focused almost exclusively on applications of nuclear energy to military uses. Meanwhile hunger, poverty, and oppression loom increasingly more important in today's world as a threat to many of the values Americans profess to hold dear.

From many quarters optimistic statements continue to suggest that atomic power can become a great force for alleviating privation and want.[1] If this view is as widespread as it appears to be, it is curious that the emphasis upon research designed to employ nuclear energy for directly constructive purposes is so slight. It is equally curious that the Atomic Energy Commission, despite the magnitude of its expenditures, has made no real attempt to assess the consequences of the introduction of an atomic technology on the national economy or to study specific means by which assimilation of such an innovation could be accomplished without severe disruption. The Commission has maintained only slight contact with social scientists, universities, and other organizations representing groups of social scientists.[2] This situation can be understood only in terms of AEC's preoccupation with applications of nuclear energy for military purposes.

We venture the judgment that such a program is dangerously unbalanced and that the need is greater than ever before to rectify this gross inequality in the resources applied to the various research approaches. The recent announcement of the generation of atomic electricity at Arco, Idaho, only underlines this premise.

The only independent volume on the economics of atomic power which has so far been published is that of the Cowles Commission.[3] Our own book-length analysis is scheduled for April publication.[4] There is no justification for repeating here the arguments of either volume. Since there has been no other basic research, so far as we are aware, relating directly to the impact of atomic power on an industry or an economy, it may seem a reasonable conclusion that we have nothing to say here. And the reality is that there is embarrassingly little that is new that can be said until further research is undertaken.

A NEW METHODOLOGICAL APPROACH

This situation has two positive values, however. First, it accentuates the absence of research in an area where the possible consequences of uncontrolled innovation may be devastating. Second, it gives us courage to explore the application of a new methodological approach, "input-output analysis," from the point of view of atomic power. In setting out on this relatively unchartered trail, we may succeed for some readers in only demonstrating the elementary stage of development of empirically-based economic theory. For others, we may be successful in indicating the extreme and growing complexity of an economy such as our own and the resultant difficulty of predicting specific events in the waves of reaction to the introduction of a new factor like atomic power. This becomes apparent when it is seen what an involved series of transactions collectively constitute the actual exchange of goods and services among the members of a population or among the industrial units of an economy. As a means of indicating some of these complexities and of

[1] We have set forth in several articles our reasons for doubting that atomic power will have drastic consequences of this character. Most readily available to present readers perhaps is Walter Isard and Vincent Whitney, "Atomic Power and Economic Development," *Bulletin*, V (March 1949), 73-79.

[2] It is interesting to note that the Atomic Energy Act of 1946 specifically states: "Whenever in its opinion any industrial, commercial, or other nonmilitary use of fissionable material or atomic energy has been sufficiently developed to be of practical value, the Commission shall prepare a report to the President stating all the facts with respect to such use, the Commission's estimate of the social, political, economic, and international effects of such use and the Commission's recommendations for necessary or desirable supplemental legislation."

[3] Sam H. Schurr and Jacob Marschak (directors), *Economic Aspects of Atomic Power* (Princeton: Princeton University Press, 1950).

[4] Walter Isard and Vincent Whitney, *Atomic Power: An Economic and Social Analysis* (Philadelphia: Blakiston Company, 1952).

pointing to the obstacles to development which lie beyond the model, we shall first erect a framework of economic development which we will subsequently reject as useless. To our readers who are not economists we apologize for the necessity of using so cumbersome a form of demonstration.

As a prelude to the application of input-output techniques, we repeat what we have concluded elsewhere: it is not necessary to believe in atomic miracles; to believe atomic power will find a place among the energy sources available to men is enough to commit oneself to the position that a chain of consequences will be established. The ultimate ramifications of such a chain can now be seen hardly at all.

THE ASSESSMENT OF INDIRECT EFFECTS OF ATOMIC POWER

We have already made clear our conclusion that the direct effects of atomic power on industrial development will not be revolutionary.[5] It is the indirect effects, which so far have not been subjected to analysis, which are likely to be really consequential. And it is some of these possible indirect effects which we want to suggest in what follows. We shall make use of the input-output technique being developed by Wassily Leontief and others.[6]

THE "INPUT-OUTPUT" ANALYSIS

Here a system of equations is set up, each one of which indicates the relations of a given industry with every other industry in the economy. A basic relationship is established between the volume of the output of any industry and the size of its inputs. If the technique were fully developed and if basic data were available for a given region, it could be shown to exactly what degree the introduction of atomic power and its substitution for conventional sources of power would change the input requirements of the power sector of the economy. The presumption is that the output of this sector would increase. Presumably, too, atomic stations would require electrical equipment, raw materials, labor, and so on, in amounts different from those now used in conventional power plants. Any change in the input requirements of this sector would result in changes in the outputs of the group of industries which serve this sector. As a result, there would be changes in the power requirements of each of these industries and, in fact, of all related industries. Each round of effects generates a subsequent round. The sum of all these effects on the output of a given industry can be obtained from modern computing machines.

What is now being sought experimentally are methods of better anticipating the new production practices and the new products which will accompany the successive rounds of effects. Such methods would make it possible to gauge with relative accuracy the regional impact of nuclear energy by relating atomic power stations in any given region to every industry both in the same and in other regions.

Unhappily, such precision is not yet possible. Consequently, we can only say frankly that we are unable to estimate even within broad limits the quantitative magnitude of the indirect effects of the introduction of atomic power in the American economy or in any other. What we can do is far more modest: to point out some promising ways of getting at such indirect effects whenever the requisite data for a given area become available, and to indicate the factors which restrict the expansion and growth of an economy and therefore tend to break the rounds of economic development.

II

THE ECONOMIC DEVELOPMENT OF REGION X

Conceive a region all of whose economic activities are classified by industries. Suppose that complete data are available on the distribution of the output of any industry to any other industry, including that to a category termed "Households" and comprising individuals and families, the ultimate consuming units. Looked at in another way, these data would also indicate the inputs into any given industry from all other industries. From these data we could also obtain the inputs per dollar value of output for any given industry from all other industries. Such inputs per dollar value of output can obviously be set down in a table, and, in fact, a table of this kind has been recently constructed for the United States for 1947 by the Interindustry Branch of the Bureau of Labor Statistics.[7]

Following this model, we present in Table 1 a simplified set of such inputs involving only ten industrial categories. This is for an imaginary region of a semi-industrialized nation, and since only limited data of this kind are available outside the United States, our figures are necessarily hypothetical. Although the figures have no significance for any real area, they are fully as useful for developing an analytical approach as if they were the official figures of some existing country.

Table 1 records in each vertical column the direct inputs (in cents) from each industrial group per dollar of output of the industrial group at the head of the column. Horizontally, the table indicates the proportionate contribution (in cents) of each industrial group to the dollar output of every other industrial group and of its own group. In what follows, however, we shall be interested only in the vertical columns and in their significance. Tables of this sort can, of course, be constructed for any real area as soon as data become available which show the distribution of output of any given industry among all the industries which comprise the economy.

What is the value of such a table in studying the impact of atomic power upon such an economy? The Cowles Commission study and the authors' current analysis show the probable or possible effect of the introduction of atomic power on the location of particular industries such as iron and steel, aluminum, cement, brick, and so on, without resort to this method. An interindustry transactions table cannot be expected to tell us much about how the introduction of atomic power might affect location. The conventional analysis in the studies cited is not superceded at this point.

A HYPOTHETICAL ANALYSIS

Now let us assume that in our hypothetical semi-developed Region X the introduction of relatively cheap atomic power makes it feasible to establish an

[5] *Ibid.*, chap. xi. See also, Schurr and Marschak (directors), *op. cit.*, Part II. Their conclusions are somewhat more optimistic than our own but not sufficiently so as to suggest any direct major effects.

[6] Wassily Leontief, *The Structure of American Economy, 1919–1939* (New York: Oxford University Press, 1951). Wassily Leontief, *et al.*, *Studies in the Structure of the American Economy* (New York: Oxford University Press, 1952). Walter Isard, "Interregional and Regional Input-Output Analysis: A Model of a Space-Economy," *Review of Economics and Statistics, XXXIII* (November 1951), 318–28.

[7] W. Duane Evans and Marvin Hoffenberg, *The Interindustry Relations Study for 1947* (Washington: Government Printing Office, 1951).

iron and steel works with an annual output valued at $1,000,000.[8] How will this affect other industries in terms of such factors as output and employment? Here the traditional location analysis found in our own book and in that of the Cowles Commission is of limited utility. On the other hand, a detailed table on the order of Table 1 and based on actual data would be highly suggestive. The required outputs for all other industries required to keep the new iron and steel industry operating at the $1,000,000 level could be derived directly from it. Using our Table 1—with its purely imaginary data—and equating iron and steel with our primary metals category, we could tell by reading down column 6 how much of the inputs from every industry would be required per dollar output of iron and steel. For agriculture and fisheries (item 1) the amount would be zero, for transportation (item 8) six cents, for households (item 10) thirty-four cents, representing primarily labor costs. Multiplying by 1,000,000 would give us the required inputs from every industry. This is shown in Table 2, column 1. Here we have the first round of indirect effects of the introduction of atomic power.

To produce all these first-round input requirements will require additional economic activity. For example, to produce the $40,000 of chemicals demanded by our iron and steel works (Table 2, column 1, item 5), inputs are required in turn from all the other industrial groupings. Column 5 of Table 1 shows the required input per dollar of output of chemicals. By multiplying each of these inputs by 40,000, we obtain the total direct requirements from all industries for the production of $40,000 of chemicals.

Similarly, the production of an annual iron and steel output valued at $1,000,000 requires an input of $20,000 of lumber and allied products (Table 2, column 1, item 4), of $380,000 of primary metals, machinery, and equipment (*ibid.*, item 6), and so on. In turn, the production of these requirements will demand additional inputs from other industries, the amounts of which can be obtained by multiplying the items in Table 1, column 4, by 20,000; those in column 6 by 380,000; those in column 7 by 20,000; and so on. These second-round requirements are shown in Table 2, column 2.

Now that we know the amount of inputs necessary to produce the outputs listed in Table 2, column 1, we can go on to determine the requirements of subsequent rounds in exactly the same way. The data for our third round appear in Table 2, column 3. Needless to say, computations might have been carried through a fourth and fifth round and, in fact, to a determination of the n^{th} round requirements.

TABLE 1

HYPOTHETICAL REGION X

INTERINDUSTRY TRANSACTIONS, 1952: DIRECT INPUTS PER DOLLAR OF OUTPUT

Industry Producing	Industry Purchasing									
	1 Agriculture and Fisheries	2 Food and Kindred Products	3 Textiles, Leather and Allied Products	4 Lumber, Paper, and Allied Products	5 Chemicals, Non-Metallic Minerals and Allied Products	6 Primary Metals, Machinery, and Equipment	7 Coal and Electric Power	8 Transportation	9 Trade Services, including Government	10 Households
1. Agriculture and fisheries	$0.25	$0.40	$0.08	$0.01	$0.05	$0.00	$0.00	$0.00	$0.00	$0.30
2. Food and kindred products	.05	.11	.00	.00	.03	.00	.00	.00	.02	.17
3. Textiles, leather, and allied products	.00	.01	.23	.03	.01	.02	.02	.01	.01	.07
4. Lumber, paper, and allied products	.00	.01	.01	.14	.03	.02	.01	.00	.03	.02
5. Chemicals, non-metallic minerals, and allied products	.03	.04	.04	.05	.21	.04	.05	.05	.03	.04
6. Primary metals, machinery, and equipment	.01	.01	.02	.03	.02	.38	.03	.04	.04	.03
7. Coal and electric power	.00	.01	.02	.02	.03	.02	.15	.05	.04	.00
8. Transportation	.03	.03	.02	.05	.05	.06	.02	.00	.01	.04
9. Trade, services, including government	.14	.11	.13	.13	.15	.12	.13	.17	.20	.33
10. Households	.49	.27	.45	.54	.42	.34	.59	.68	.61	.00

III

LIMITATIONS OF "INPUT-OUTPUT" TECHNIQUE: FACTORS NEEDING FURTHER STUDY

We have already warned our readers that the neat model of economic development presented in Section II is so far removed from real economic activity as to be useless. In fact, to take it literally would be to do harm to all subsequent analysis. We shall attempt to show why by indicating some of its limitations and the kind of qualifications which are necessary if reality is to be approximated.

We begin by returning to our original assumption that cheap atomic power is made available in our hypothetical semideveloped region. Production of such power itself requires inputs from other industries—a fact which we illogically ignored above. But what, specifically, are these requirements? No one knows since no experience with atomic power production is available. Fortunately, we can circumvent this difficulty (although we would prefer not to) by assuming that our semideveloped region is a satellite which gets its atomic power from a neighboring parent country over transmission lines.

The availability of cheap atomic power makes it feasible to utilize local ore deposits, labor supply, and so on, in a new iron and steel industry with an annual output value of $1,000,000. (For this assumption to be realistic, the iron and steel produced will have to be originally either for the export market or as a domestic substitute for iron and steel now imported.) What are the input requirements for this iron and steel output? If the industry is new to the region, obviously local data are not available. A fair approximation could be obtained, however, from technical journals or from a study of plants elsewhere[9] with the exact production process stipulated in advance.

In economic development the character of the initial industrial impulse

[8] This is the kind of assumption frequently made but, in our judgment, is overoptimistic. It demands not only cheap atomic power but also lack of competitive power resources, absence of obstacles to atomic power entry, and so on. For our position, see *Atomic Power, op. cit.*, chap. v. Our acceptance of the optimistic assumption here is only for purposes of analysis.

TABLE 2

HYPOTHETICAL REGION X

INPUT REQUIREMENTS, BY ROUND, FOR $1 MILLION OUTPUT OF PRIMARY METALS

Industrial Grouping	First Round Input Requirements (1)	Second Round Input Requirements (2)	Third Round Input Requirements (3)
1. Agriculture and fisheries	$ 000	$ 105,800	$ 144,180
2. Food and kindred products	000	61,400	67,130
3. Textiles, leather, and allied products	20,000	39,200	37,368
4. Lumber, paper, and allied products	20,000	22,400	21,046
5. Chemicals, non-metallic minerals, and allied products	40,000	46,600	45,660
6. Primary metals, machinery, and equipment	380,000	164,200	85,740
7. Coal and electric power	20,000	21,600	22,128
8. Transportation	60,000	41,400	33,256
9. Trade, services, including government	120,000	205,800	203,502
10. Households	340,000	291,600	339,990
Total	$1,000,000	$1,000,000	$1,000,000

varies significantly with the nature of the industry. Historically, the degrees of agglomeration which have occurred at specific sites have reflected the ability of given industries to attract a concentration of ancillary plants. Steel has always exerted what may be termed a primary agglomeration effect. In other words, it has attracted to its location a relatively great number of other industrial plants. One obvious reason for this, among a host of factors influencing location, is the advantage for steel-fabricating plants, so important in an industrialized economy, of location near the material which they consume in such large quantities. Steel fabrication traditionally involves heavy employment. Thus, basic iron and steel industry not only induces an agglomeration of plants but simultaneously a sizeable aggregation of population. It is estimated that for every person employed in the U.S. Steel works now under construction at Morrisville, Pennsylvania, six persons will be employed in new steel-fabrication plants. (Obviously location factors other than proximity to a steel plant are important here. Particularly influential is the sizeable market area close at hand.) By contrast, there are industries like aluminum which do not pull fabricators.

In our hypothetical region any establishment of an iron and steel industry with an annual output valued at $1,000,000 is likely to attract steel-fabricating plants to adjacent locations. Suppose, as is not unreasonable, that the annual value of the latter's products will be $3,000,000. The impulse toward increased industrialization thus has at the start both a much broader base and greater lasting power than would be true of some other primary metals operations. Establishment of new aluminum output with an annual value of $1,000,000, for example, might induce at most only some $500,000 of additional fabrication output. Thus a first major consideration of any development process stimulated by atomic power—and one which is neglected by our model in Part II—is a detailed observation of the kind of initial agglomeration effect which is to be anticipated.

SOURCE OF INPUTS

We now assume that we know the input requirements both of our hypothetical iron and steel works and of the total of fabricators, users of by-products, and other ancillary plants which will tend to locate in the immediate area of the steel works. These are the real first-round requirements and can be listed as in Table 2, column 1.

What is the source of these inputs? If they can be produced domestically, the industrialization impulse will be more profound than if they are imported. This would not be true, of course, if the materials imported to Region X were exactly matched by new demands for export goods from the region (though even here the kinds of goods manufactured domestically would influence the character of economic development). Customarily, however, the return demand for such a region as we have posited is vastly smaller than the region's own import demands.

The source of the input requirements in the first round is most likely to be domestic where agricultural products, local timber and ores, etc., are employed. To be specific, Table 2, column 1 indicates that $40,000 of chemicals and zero dollars of agricultural products are required as first-round inputs for our model. If Region X is relatively undeveloped, it is probable that the chemicals required will all have to be imported. Quite possibly, depending upon topographic and climatic conditions and upon custom, all agricultural products will be available domestically. In some respects, at least, the industrialization impulse would be better promoted by an industry which requires some inputs of agricultural products and a correspondingly lesser amount of inputs of chemical products. At any rate, our model displays another inherent inadequacy in its failure to account for these "leakages"—factors which retard or even prevent the continuation of the industrialization impulse.

A comparison of the dollar totals in all three columns of Table 2 will show that these totals for the input requirements of the first, second, and third rounds, respectively, do not converge. Rather, they remain at $1,000,000. In reality, any such leakage as is indicated by the probable need to import chemicals without equivalent return demands for exports will cause these totals to converge. The greater the leakage, the more rapid is the convergence. In the extreme case, where all inputs must be imported, there is no second round of effects. This underlines the important distinction among industries which might follow the introduction of atomic power into Region X. Other things being equal, the impact of such industrialization will be strongest where input requirements can initially be provided from domestic sources.

Another leakage which may hamper industrial growth, especially in underdeveloped areas, is revealed by an

[9] Following World War II the Bureau of Labor Statistics made certain studies of the German economy in which the input structures of principal industries were based on experience in the United States. W. Leontief "Input-Output Economics," *Scientific American*, Vol. 185 (October 1951).

examination of the second-round effects. Here the category "Households," which includes service of labor and of capital and land owned by individuals, is of prime importance. As shown in Table 1, the value of inputs from households per dollar value of output of the several industrial groupings specified is rather consistently high. Consequently, in each round, households receive a large fraction of the amount spent on inputs.

What happens to these wages and salaries, profits, dividends, and rents? An extreme possibility is that they might be held idle by hoarding. Since they are not channeled into investment either directly or indirectly, subsequent rounds of expenditures necessarily become smaller. If the $340,000 (Table 2, column 1, item 10) going to households as wage payments and as dividends, rents, and profits were all hoarded, the second-round expenditures would fall from $1,000,000 to $660,000; and, under the same assumption, third-round expenditures would amount only to $368,400. Even if hoarding does not reach 100 per cent, it occurs at a significant rate in many cultures. And wherever it does, it constitutes a major leakage.

In our model (Table 1, column 10), it was assumed that every dollar of income received by households was spent. This is hardly a realistic assumption. In practice, the expenditures per dollar of income listed in column 10 of Table 1 would rarely add to a dollar. This is true despite the fact that the pattern of expenditures for households (or for any industry) ordinarily varies from one round to the next, and with it the amount of hoarding and hence the degree to which the rounds of expenditures converge. For example, it is well established that, in industrial societies, as income rises the proportion spent on food tends to decline while that spent for services tends to rise. This important type of leakage can seriously retard whatever initial impetus to industrial development may be given by atomic power.

CAPITAL REQUIREMENTS

Perhaps the chief obstacle to any atomic-inspired industrialization, however, is a lack of capital. To produce iron and steel, to perform the myriad operations involved in steel fabrication, to secure domestically the various inputs which are required in the first, second, and succeeding rounds of production necessitates heavy investment in plant, equipment, transportation facilities, and so on. Numerous estimates have suggested that, on the average, the investment required per industrial worker would be from $1,000 to $2,000 at the minimum, varying, of course, with the type of economic activity. The problem of where the capital is coming from is one that particularly plagues nonindustrialized countries.

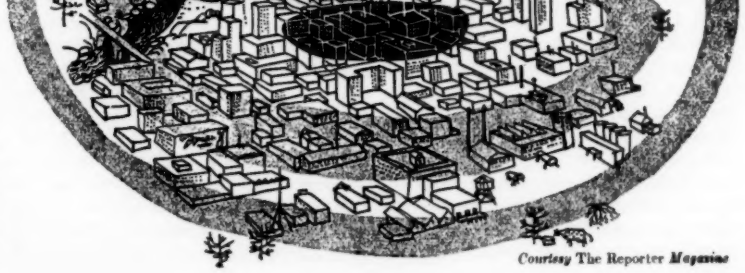
SAVINGS

It is certain that the successive rounds of expenditures cannot remain large unless there is expansion of domestic capacity for items required as inputs which can be locally produced with profit. But this potential limiting factor is correlated with the leakage from households already pictured. We have said that in industrial societies, some part of each dollar earned is likely to be privately hoarded. To the extent that this does occur in a given society, it tends to cause a convergence of the series of expenditures. Conversely, any savings which are returned to the expenditure stream by being used to purchase the inputs for construction of roads, factories, and the like, tend to prevent such convergence. Such saving is ordinarily vital to successful economic development. If there were no saving—and no private hoarding—every dollar earned would be spent. Since there would then be only limited capital available for investment. a lack of domestic capacity would prevent production at home of the inputs required for continuing economic expansion. To overcome this problem would require imports from abroad, which would be potential sources of important leakages. On the other hand, if individuals did save some part of their dollar earnings, this part could be used to purchase inputs, and the expenditure stream would not be diminished by being diverted in some degree to a foreign area. Thus savings could play a critical role in the ultimate success or failure of an iron and steel industrial development induced by atomic power.

There is another aspect of the critical role played by savings. In countries where capital is scarce, there is ordinarily an inadequacy of transport facilities and other internal improvements. Much of the capital required in new industrial undertakings must go, then, into such things as rail lines, roads, and port facilities. Happily, such investment will promote the productivity of both the agricultural and industrial sectors of the economy, including those which antedate the sectors stimulated specifically by atomic power. This means that fewer dollars of inputs are required to produce given amounts of product. Looked at in terms of Table 1, the dollar value of output of any industry comes to correspond to a greater amount of product. Inputs per unit of capacity would require fewer dollars. This situation is obviously favorable to a spiraling rate of industrialization.

MARKET EXPANSION

Another factor favorable to the expansion of the expenditure stream is the tendency for any rise in income and any accompanying increase in the total consumption of households and other industrial groupings to attract additional economic activity and especially to promote new manufacturing aimed at the home market. Because of this, we would expect in our Region X additions to the input requirements corresponding to each round. Thus, after the second round of expenditures has been effected (Table 2, column 2), the market may well have expanded sufficiently to induce the location of several new manufacturers. If so, in addition to the $45,660 of inputs



Courtesy The Reporter *Magazine*

of chemicals (column 3, item 5) required to produce the outputs corresponding to the second-round requirements, another $10,000 of chemicals may be necessary for the new plants. Similar additional requirements must be assumed for each of the other industrial groupings affected. This means that the total requirements in the third round, and in successive rounds, will increase. Such expansion implies increasing productivity and living standards.

THE POPULATION FACTOR

Of the many additional factors which are consequential in any real process of economic development—and which cannot be held constant by assumptions which are essential elements of the theoretical construct—there is space to comment on only one. This is the population factor.

It is obvious that, in order to continue the expansion of the expenditure stream, the requisite labor force must be available. As the requirements of each sector grow, additional laborers are needed. If a region is thinly populated so that, at the existing level of technological development, there is a critical shortage of labor, this can immediately restrict expansion. It may do so by hindering or preventing the growth of economic activity as a whole or by making the expansion of some industries possible only if others, equally needed, contract. In this case, the net expansion of the expenditure stream becomes much smaller than the gross expansion of a particular sector would suggest.

A more probable situation in underdeveloped areas, however, is one in which population relative to available resources is dense. There is marked unemployment, frequently in the disguise of underemployment. Typically, these are agricultural economies in which five or more persons may expend full working time on tasks which can be performed with equal or greater efficiency by four or three, or even two, persons who operate with an improved technology, have a superior diet, and so on.

In an economic sense, these "surplus" laborers are available for industrial employment. Quantitatively, lack of labor force need not prove an obstacle to increasing industrialization. Nevertheless, we must not ignore the reality that in overpopulated agricultural countries increases in productivity must occur at a more rapid rate than increases in population if the mechanization of economic activity, including agriculture, is to continue. Otherwise the initial surplus will be swallowed by the subsistence requirements of the additional number of people, and the country will revert to its prior condition.

Furthermore, even if labor supply is not a problem in quantitative terms, it is likely to be one qualitatively. Despite the fact that social organization may exhibit great flexibility under certain conditions, an established way of life is not rapidly altered without overcoming strong resistances. Industrialization may be opposed by inertia. More positively, it may be viewed as a threat to an established system of values. Even the small elite with power to initiate change may reject economic development as a danger to the *status quo* and therefore to their dominant positions. In terms of labor force, opposition may occur through a host of factors including non-acceptance of industrial employment, for whatever reasons, by large numbers of potential workers and, where such work is accepted, inefficiencies in individual response which are rooted in the social organization of the country. For reasons of this kind, plants which might in theory be introduced into Region X after the second round of industrial expansion, may, in reality, be prevented by a qualitatively inadequate labor force or by other types of resistances. In fact, the steel-fabricating plants, which normally would have been anticipated around the iron and steel plants at an earlier point, may not have developed for the same reasons. Inefficiencies of this type can readily convert low money wages to real wages which are too high to be competitive or even, at a given stage, to be justified on a basis of economic nationalism.

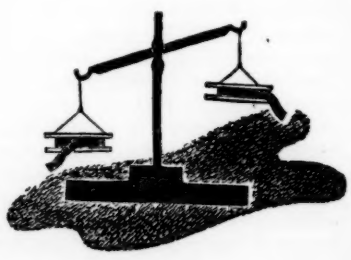
CONCLUSIONS

To summarize, even if the lack of validity of any present estimates of cheap atomic power is taken into account, it is easy to overemphasize the probable role of atomic power in economic development through a failure to comprehend the extreme complexity of the process. Complexity does not, of course, automatically spell failure. Evidence to the contrary is widespread. Nevertheless, the ability of a region to become industrialized, given cheap atomic power, may be made to appear greater than it is by the necessary inability of existing theoretical models to allow for the kind of obstacles inevitably found in the real situation.

Still, properly used, such a technique as an interindustry transaction table, showing direct inputs per dollar of output, holds promise for a more rational comprehension of the dynamic character of an economic system. We have presented it here very briefly as a device for assessing in quantitative fashion, and perhaps with a little less vagueness than we must otherwise confess to, some of the specific relationships in such a system and some of the consequences of an impact at one point upon the ramifications of the system. We have, at the same time, attempted to picture the complex character of the process of economic development and to imply that the introduction of atomic power into an area cannot be easily equated with the accomplishment of an industrial and social transformation.

NOT REVOLUTIONARY

We believe, as we have stated frequently before, that atomic power (if not superceded by such another force as solar energy) will be a most welcome addition to the existing power resources of various regions, but perhaps particularly to those which are already industrialized. We do not believe that atomic power is likely to be a revolutionary new kind of force in speeding economic development and raising standards of living around the earth. Yet, it must be obvious that both current knowledge and current methods of analysis are so imperfect that any conclusions we can draw must be tentative. They represent our considered judgment. More precise answers wait upon more effort to develop basic social science research knowledge and, so far as our special interest here goes, to apply such knowledge directly to the study of the impact of atomic power. That this slow, arduous, and often painful road is the only one which can reward us with meaningful answers is a philosophical assumption to which we subscribe.



Books

Mr. President. By William Hillman. With Photographs by Alfred Wagg. New York: Farrar, Straus and Young, 1952. Pp. 253. $5.00.

AS MOST of this magazine's readers will know already from other sources, this is an extraordinary book based upon the extraordinary opportunity given Mr. Hillman, a radio commentator, to go through Mr. Truman's personal and official file with the avowed purpose of letting "the American people know their President as he is." It is said that no other head of state has ever, while in office, revealed so much of his convictions, his personal sentiments on men and events.

But the fact is that the book, while very revealing of Mr. Truman's personality and mode of thinking, contains very little really new material as to his policies and throws very little light on how decisions were taken. What it does is to give very open and intimate glimpses of Mr. Truman's personality and of his intentions. Naturally, political controversy has raged about some passages of the book, but nearly all reviewers and commentators agree that the President in a very novel way tried to give an honest picture of himself and succeeded.

His comments on atomic energy are about what would be expected by anyone who has studied his official announcements on the subject, and yet they are interesting in their very direct form. Perhaps they should be prefaced with some more general remarks which he has in the book. The President's very American belief in progress he puts in three paragraphs:

"History is a story of improvement even if there are setbacks. There was an improvement from the time of Hammurabi and Rameses to Rome, and when Rome blew up, then everything went back a thousand years.

"Since the Renaissance there has been a constant improvement.

"But another world war would put civilization back some thousand years or more."

Gerald Johnson, the historian, says of these remarks:

"Thucydides, Ibn Khaldun, Hegel and Toynbee might reel under the impact of that, but it is a philosophy of history, all right, and it can be defended as plausibly as Spengler's equally arrant pessimism. Doubtless no scholar would have been as forthright, but few scholars would have been as clear."

It has frequently been said that President Truman learned of the Manhattan District Project while he was chairman of the "Truman Committee," but in this book the President says he did not learn of it until about ten days after he became President. About the decision to use the bomb, he says:

"I first learned about our vast project of atom splitting about two weeks after I became President.

"While a Senator and chairman of the special committee to investigate the national defense program, I had come across an important project, the details of which were hard to ascertain. I sent a special investigator to look into the matter. Secretary of War Stimson then informed me that the project involved a topmost secret. I immediately called off the investigator, and said I did not want to know anything more about it.

"The secret was disclosed to me as President by James F. Byrnes, who had been Director of War Mobilization under President Roosevelt, and Fred M. Vinson, who had succeeded Byrnes. On April 25th, Secretary of War Stimson went over the whole project with me.

"President Roosevelt had initiated the project, its primary aim being the use of atomic energy for military purposes. The object of the huge expenditure was to be the first to develop an atomic weapon and to use it. The Germans were trying to create such a weapon.

"On July 6th I left for the Potsdam Conference to meet with Churchill and Stalin. While at Potsdam I received a message saying that the scientists had made a successful test at Los Alamos, New Mexico, on July 16th.

"I went into immediate consultation with Byrnes, Stimson, Admiral Leahy, General Marshall, General Arnold, General Eisenhower and Admiral King. I asked for their opinions whether the bomb should be used. The consensus of opinion was that the bomb should be used.

"We were planning an invasion of Japan with the use of 2,000,000 men and the military had estimated the invasion might result in very heavy casualties. In April I had appointed an interim committee to make recommendations on questions of policy when and if an atomic bomb could be made. The committee consisted of Secretary Stimson, George L. Harrison, James H. Byrnes, William L. Clayton, Dr. Vannevar Bush, Dr. Karl T. Compton, and Dr. James B. Conant. Before I had left for Potsdam the committee had recommended that the bomb be used against Japan.

"General Marshall said in Potsdam that if the bomb worked we would save a quarter of a million American lives and probably save millions of Japanese.

"I gave careful thought to what my advisers had counseled. I wanted to weigh all the possibilities and implications. Here was the most powerful weapon of destruction ever devised and perhaps it was more than that.

"Conscious of how great a responsibility had been placed on me I suggested to Secretary Stimson that we give Japan a warning in advance by sending Japan an ultimatum to surrender. Some weeks earlier, Stimson had been urging some open declaration or message to the Japanese. I now felt the time was opportune.

"I then asked Stimson to indicate on the map what cities the military would favor as targets, if Japan did not surrender, and we had to use the bomb. Among the targets was Hiroshima, an army center and a military supply port; and Nagasaki, a major seaport containing large industrial establishments.

"I then agreed to the use of the atomic bomb if Japan did not yield.

"I had reached a decision after long and careful thought. It was not an easy decision to make. I did not like the weapon. But I had no qualms if in the long run millions of lives could be saved.

"The rest is history.

"In my statement, released from the White House on August 6, 1945, I said:

" 'The fact that we can release atomic energy ushers in a new era of man's understanding of nature's forces. Atomic Energy may in the future supplement the power that now comes from coal, oil and water.'

"This is even more certain today.

"We must harness this great energy source of nature unlocked by man for the benefit and not the destruction of man. Today it helps protect us, tomorrow it will also serve us."

The newspapers seized upon one small paragraph of the book in which the President says that he was visited by a "Mr. X" in September 1946, who the newspapers have widely identified as Mr. Wallace. The text of the paragraph was:

"Mr.——spent two and one-half hours talking to me yesterday. I am not sure he is as fundamentally sound intellectually as I had thought. He advised me that I should be far to the 'left' when Congress was not in session and that I should move right when Congress is on hand and in session. He said F.D.R. did that and that F.D. never let his 'right' hand know what his 'left' hand did.

"X is a pacifist 100 per cent. He wants us to disband our armed forces, give Russia our atomic secrets and trust a bunch of adventurers in the Kremlin Politbureau. I do not understand a 'dreamer' like that. The German-American Bund under Fritz Kuhn was not half so dangerous. The Reds, phonies and the 'parlor pinks' seem to be banded together and are becoming a national danger."

To this, Mr. Wallace replied:

"Only scattered fragments of Mr. Truman's diary are included in this book. The passages which do appear have been carefully selected for a definite purpose. Hillman and Truman must have known that the blacking out of my name in the September 19, diary entry would merely whet newspaper appetites and lead to maximum discussion and sale of the book.

"They knew that newspaper men would conclude that Mr. X was I. Why then did Truman and Hillman print in 1952 a passage indicating that sixteen months after the close of a most ruthless war against Germany, Truman considered me to be twice as dangerous as the Nazis? Mind you, this diary entry was only a day after he told me he liked Stalin and could do business with him."

Mr. Wallace added:

"If Mr. Truman ever admits 'Mr. X' is I, I shall charge him with the same deliberate character assassination which he finds so despicable in others."

It is interesting to note that the President seems to base his main hopes for the peace of the world upon the Point IV program. On this subject in the latter part of the book, he says:

"I consider Point Four a practical answer to a growing crisis in a world torn between aggression and peace.

"The Truman Doctrine, the Marshall Plan, the North Atlantic Pact, the mobilization program and the action by the United Nations in meeting the military aggression in Korea were steps dictated by a series of emergencies.

"We have bought time at great expense and a terrible cost of lives and fortune and now we must use that time intelligently and courageously. We face serious trouble unless we realize that our own welfare and that of the rest of the world depend upon the constant and dynamic expansion of the world's resources. The fears that the world is growing too small are groundless. There is room and shelter and food for millions more if we put our know-how to work.

"Point Four takes its name from the fourth position on recommendations to Congress in my inaugural address in 1949. Point Four is not intended to be a wholesale give-away plan.

"Briefly stated, Point Four is a proposition to take over the gap that is left by the failure of colonialism, only it is different from colonialism in that its objective is to help people to help themselves, with the theory that prosperity of all parts of the world means the prosperity of the whole world."

—M. A.

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U.N. NEWS—DISARMAMENT

(*Continued from page 118*)

which left the matter more open for investigation than the previous one, India and Indonesia abstained from voting and made it clear that they preferred not to take sides on any question where there was danger that it would tend to enlarge the area of disagreement among the great powers. They would gladly vote for any proposal on which the great powers were agreed.

The Disarmament Commission held its first meeting in Paris on February 4. With certain modifications, the rules of procedure of the now dissolved Atomic Energy Commission were adopted. (Following the Assembly's January 11 recommendation, the Commission on Conventional Armaments had been dissolved by the Security Council on January 30.) The chairmanship of the new Commission will rotate monthly and in principle the meetings will be open. The first report is to be submitted to the Security Council and the members of the United Nations by June 1, 1952.

In summary, it would appear from the record that although some progress has been made toward eventual agreement on the subject of disarmament, this progress relates mainly to procedural matters, and there is still sharp disagreement on basic principles. So far, the United States has succeeded in retaining majority support for its ideas, while making a concession in finally allowing the ideas contained in the Soviet amendments to be transmitted to the Disarmament Commission. The extent of the apparent Soviet concessions on simultaneous prohibition and control of atomic energy and on continuing inspection remains to be clarified. Attention is called to the article of David F. Cavers in the March 1952, *Bulletin*, in which it is pointed out that the problem has changed, now that new machinery has been set up for disarmament planning, and that, whatever their views in 1946, at the present time the United States Senate and people might be more likely to share the Soviet preference for national ownership.

EDITOR'S NOTE—

On April 5, as this issue went to press, a working paper was submitted to the Commission by the U. S., entitled "Proposals for the Progressive Disclosure and Verification of Armed Forces and Armaments." *Cf. New York Times*, Sunday, April 6, p. 44.

News and Notes

Prepared by Peter Axel

INTERNATIONAL SCIENCE

At a Unesco-sponsored meeting, February 12–15, of twelve European nations, a Council was established to plan an international laboratory and to organize other forms of cooperation in nuclear physics research. This Council of Representatives, which will meet in Geneva, will control all phases of scientific cooperation and will function independently of Unesco. The estimated budget for this year of $220,000, will be supplied by France (31 per cent), Germany (15 per cent), Italy (11 per cent), Switzerland (10 per cent), Belgium (9 per cent), The Netherlands (5 per cent), Sweden (5 per cent), Yugoslavia (5 per cent), Denmark (4 per cent), Norway (3 per cent) and Greece (2 per cent). Great Britain, whose representative attended the meeting, has not been committed to join formally or financially aid the Council.

The proposed laboratory is being planned by study groups. It is expected to contain a 500-million electron-volt cyclotron and a 3 to 10 billion electron-volt cosmotron. Construction will not begin for at least two years. Another part of the Council's activities will be the support of a special study group at the Institute for Theoretical Nuclear Physics at Copenhagen.

Forty delegates and observers participated in the Geneva Conference. Among them were: Professors Werner Heisenberg (Germany), J. L. Verhaeghe (Belgium), Niels Bohr and Jakob Nielsen (Denmark), Francis Perrin (France), Démètre Hondros (Greece), G. Colonnetti (Italy), O. Dahl and E. Hylleraas (Norway), O. J. Bakker (Netherlands), Sir George Thomson (United Kingdom), Hannes Alfven and Iwar Waller (Sweden), Peter Preiswerk and Paul Scherrer (Switzerland), A. Peterlin and Paule Savic (Yugoslavia). Unesco was represented by Professor Pierre Auger, director of the Department of Natural Sciences.

This information was released by Gerald Wendt, director of Public Education in Science of Unesco, whose office has just started to function.

APPROPRIATIONS

An economy-minded House of Representatives accepted the Appropriations Committee recommendation to cut the proposed AEC budget by 15 per cent ($174 million). The Appropriations Committee also proposed a 77 per cent ($11.5 million) reduction in the National Science Foundation budget.

Representative Durham, vice-chairman of the Joint Congressional Committee on Atomic Energy, and the eight other House members complained without avail that the AEC reduction would hamper the development of the H-bomb and threaten "our atomic superiority over Russia." Durham further added that this would "cut the heart out" of the atomic program and would slow "to a walk" the effort to build atomic-powered aircraft and submarines. However, Representative Thomas, of Texas, chairman of the subcommittee which wrote the bill, insisted that no curtailment of operations would be necessary. He asserted that "the AEC is the most wasteful of all government agencies." Representative Thomas maintained that weapon development would not be slowed by "five minutes" since most of the cuts were for salaries and expenses.

The NSF cut was justified by the House committee on the grounds that NSF "is a new activity which is unlikely to provide assistance to the country in the immediate emergency." Thus, the 77 per cent reduction went relatively unnoticed both by the House and by the press.

The next test for the NSF appropriation will come before the Independent Offices Subcommittee of the Senate Appropriations Committee.

APPOINTMENTS

Lewis L. Strauss, former AEC member, was named to head an advisory panel to the Joint Congressional Committee in connection with atomic plant expansion. According to Senator McMahon's announcement on March 6, the panel will advise the Committee about material priorities, labor relations, and contractual and organizational problems. Mr. Strauss was a former partner in Kuhn, Loeb, and Co.; he was a rear admiral during World War II and has been financial adviser and consultant to the Rockefeller family since 1950.

In addition to Mr. Strauss, the panel will consist of: Mr. Ralph A. Bard, former Under-Secretary of the Navy; Mr. James B. Carey, of the CIO; Dr. Karl Compton, former chairman of the Research and Development Board; Mr. Roy T. Hurley, president of the Curtiss-Wright Corporation; Mr. Ralph E. McGill, editor of the Atlanta *Constitution;* and Mr. Boris B. Shishkin, of the American Federation of Labor.

Dr. Urner Liddell was appointed on March 3 as chief of the Physics and Mathematics Branch, Division of Research, of the AEC. Dr. Liddell has been the director of the Division of Physical Sciences, Office of Naval Research, and has administered the AEC-ONR joint program in nuclear physics research. He entered the Navy in 1942 and four years later, at the age of forty, became the head of the Physics Branch of ONR.

SPIES

Julius and Ethel Rosenberg, sentenced to death as atom spies, petitioned the U.S. Court of Appeals on March 12 for a rehearing. This petition claimed that the Rosenbergs were sentenced as "traitors" without the benefit of the "protection of the two-witness rule constitutionally provided in such cases." Emanuel Bloch, their defense counsel, claimed that they were "thus subjected to a treason prosecution under the camouflage of a 'conspiracy to commit espionage' charge."

Mr. Bloch also included in his appeal two points which had been made in the original appeal already denied by the court. These were (1) that the trial judge was unfair; and (2) that there was no evidence that the Rosenbergs personally adhered to or even knew of the tenets of the Communist party. [As this issue went to press it was learned that this appeal had been denied.—*Ed.*]

FROM ABROAD

According to Jesse Johnson, head of the AEC Raw Materials Division, South Australia is ready to become a significant producer of commercial uranium. Mr. Johnson made this statement during a visit to Adelaide, Australia, early in March.

The Canadian Atomic Energy Control Board has requested a $17.6 million budget from Parliament. The sum includes $7 million for the construction of a new reactor and auxiliary buildings.

Atomic Energy of Canada Ltd. has been formed to manage the three piles at Chalk River, Ontario. Dr. C. J. MacKenzie, president of the National Research Council and chairman of the Atomic Energy Control Board, will be the president of the new corporation.

COOPERATION WITH BRITAIN

Dr. James B. Conant called for a re-establishment of cooperation in nuclear physics between the United States and Britain. Speaking at the London School of Economics on "Anglo-American Relations in the Atomic Age," Dr. Conant deplored "the fact that success in nuclear physics has become a matter of national and political pride." He also criticized the "gross distortion of the facts presented to the public" and the security regulations which make it difficult to correct these distortions.

In calling for a just balance between the demands of security and the demands of liberty, Dr. Conant said, "We must preserve the integrity of individual relations in university communities by repudiating any idea of academic informers and stool pigeons or cloak-and-dagger investigations."

On the following day, Dr. Conant charged that American security rules are "viciously" interfering with cultural exchanges between the United States and other friendly nations.

VISAS

On March 14, the British government refused entry visas to a group of scientists who were planning to attend an international meeting of the World Federation of Scientific Workers on March 22 and 23. The organization is headed by Professor Frederic Joliot-Curie. Scientists who were to have attended the meeting, according to the Federation, included Vassily Nikitin, a member of the presidium of the Soviet Academy of Sciences; Mrs. Irena Nikitina, Professor Ivan Lebedev, president of the Soviet Higher Institution for Scientific Workers; Professor Tsien-san Tsiang and Dr. Chi-tsin Jen, of China; Professor Zygmunt Kuligowski, of Poland, and Professor I. Malek, of Czechoslovakia.

The British Home Office did not give its reasons for refusing the entry permits.

SECURITY

Congress has passed a bill which transfers from the FBI to the Civil Service Commission the "routine" job of conducting initial investigations of persons seeking jobs with the AEC, foreign-aid programs, and some half-a-dozen minor agencies. The FBI will still check applicants for especially "sensitive" jobs if requested to by any agency. Senate-House conferees rejected a House rider which would have made the personnel security files available for congressional inspection.

NUCLEAR PLANE

The Air Force disclosed on March 12 that a contract had been awarded to Boeing Aircraft Corporation for work toward building a nuclear-powered airplane. The Boeing Company is to work in conjunction with Pratt and Whitney Aircraft of East Hartford, Connecticut.

MUSIC

Physics Professor Arthur Roberts' "Overture to the Dedication of a Nuclear Reactor" was given its premiere by the Oak Ridge Symphony under the direction of Waldo Cohn, biochemist-conductor, on March 19. It was well received, particularly by those scientists who recognized in it the excitement of a reactor "going critical." "It is serious music in that it is intended to stand on its own merits of music even without knowledge of the program," explained Professor Roberts. "However, it is not solemn, but humorous." The composer further displayed his virtuosity by using themes based on numbers common in atomic energy work (such as the atomic numbers of uranium and plutonium) and on familiar letter combinations (such as AEC).

"SCIENCE FOR PEACE"

On January 22, 1951, a meeting of about two hundred scientists was held in London to "coordinate efforts for peace." It elected a committee that drew up the following statement:

We are now in danger of a third world war and we are determined to do what we can both as citizens and scientists to prevent it. . . .

The weapons of modern war are a product of scientific technology. Their increasing destructiveness is compelling scientists to recognize their moral responsibility. It is our duty to appeal to peoples and governments for a negotiated and lasting settlement which will prevent a recourse to these instruments of extermination.

It is our duty to provide the public with information both on the destructiveness and misery of modern war and on the benefits that constructive science can bring.

We assert the international character of science; it is a world-wide republic of the mind. Scientists form one fraternity, united in a common attempt to understand nature and a common concern for human betterment. It is our duty to strive for the removal of all barriers that restrict or embarrass the free intercourse of scientists thoughout the world.

This statement was endorsed by twenty-six prominent British scientists, among them: Lord Boyd Orr, Professor C. H. Waddington, R. A. Gregory, Professor J. D. Bernal, Professor C. A. Coulson, F. Yates, Professor M. Born, J. Needham, D. M. Needham, Alex Comfort, Professor F. G. Gregory, Professor Kathleen Lonsdale, Professor J. B. S. Haldane, and Professor C. F. Powell.

The committee proposed to establish a "national peace organization of scientists."

On January 19–20, 1952, this organization held a first national conference in London attended by 180 scientists, at which two resolutions were adopted unanimously. The first dealt with the necessity of effective elimination of atomic weapons and asserted that "there are no insurmountable technical difficulties in the way of establishing an effective system of control and inspection, containing in itself automatic guarantees of its fulfilment and possible to operate even in a period of international tension. . . . The differences in policy between the various countries . . . are capable of resolution by compromise. In particular, the stress that has been laid on international ownership of large-scale atomic establishments is not justified. Although such ownership might facilitate control it is not essential. . . . Since it constitutes a major stumbling block we respectfully submit to our government that it should use its influence to secure that this proviso is not allowed to hold up a general agreement."

The second resolution dealt with biological warfare, and called upon the British government to "(i) enter into negotiation with other governments with a view to a general formal repudiation of any use of biological warfare and to working out practical measures to ensure that this repudiation is effective; (ii) to refrain from imposing conditions of secrecy upon workers at any government-sponsored research institute engaged in work which might bear on the problems of biological warfare; and to allow inspection of such institutes by accredited representatives of a recognized international organization; (iii) to secure the full publication of the results of all such research, including secret work already completed, whether or not it was directly concerned with biological warfare."

The conference secretary points out that this resolution does not advocate unilateral abrogation of secrecy, but that recommendations (ii) and (iii) were intended by the proposer to be contingent upon (i).

"THE BEST LEADERSHIP AND FOLLOWERSHIP"

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